

1 **Can't get no satisfaction:**
2 **Examining the relationship between commuting and overall life satisfaction**
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40

1 ABSTRACT

2

3 Commuting to work and school can be viewed as an unpleasant and necessary task. However,
4 some people enjoy their commutes, and trip satisfaction can have a positive impact on overall life
5 satisfaction. The purpose of this study is to analyze the relationship between individuals'
6 satisfaction with their commuting trips and their reported overall life satisfaction. This study is
7 based on the results of the 2015/2016 McGill Commuter Survey, a university-wide travel survey
8 in which students, staff and faculty described their commuting experiences to McGill University,
9 located in Montreal, Canada. Using a Factor-Cluster analysis, the study reveals that there is a
10 relationship between trip satisfaction and the impact of commuting on overall life satisfaction. One
11 result of the study shows that cyclists and pedestrians have the highest overall trip satisfaction,
12 report that their life satisfaction is most impacted by their commute, and have the highest overall
13 life satisfaction. Also, for all mode users, one or two clusters exhibit lower trip satisfaction, report
14 that satisfaction with their commute does not greatly influence their life satisfaction, and claim
15 having access to and using fewer modes relative to other users of the same mode. These results, in
16 addition to the results that active mode users have high life and trip satisfaction, suggest that
17 building well-connected multi-modal networks that incorporate active transportation can improve
18 the travel experience of all commuters.

1 INTRODUCTION

2
3 Individuals' quality of life (QOL) and subjective well-being (SWB) are influenced by many
4 factors. One of these factors is an individual's commuting experience, which is often perceived as
5 both unpleasant and fatiguing, as well as a mandatory part of life (1; 2). However, not all
6 commuters perceive their daily trips to be negative, and many people enjoy their commutes.
7 Furthermore, a positive commuting experience can contribute to overall life satisfaction (3; 4). In
8 other words, commuting can be a favorable experience that positively contributes to an
9 individual's happiness. In contrast to the work commute, travel can be undirected, meaning that
10 instead of being derived by demand, individuals travel for enjoyment (5). One reason that
11 satisfaction can result from commuting is due to the ability to engage in multiple activities while
12 traveling, such as working, reading, listening to music or simply gazing out the window (6).
13 Personality and attitude can also influence the enjoyment derived from travel, and individuals who
14 do not enjoy travel will often try to reduce it, in contrast to an individual who enjoys travel (1).
15 Therefore, not all individuals seek to minimize their travel (5).

16 Research on QOL and travel were first integrated in the 1970s by Stokols et al. who
17 examined the relationship between commuting and stress (7). These researchers found that
18 commuters with longer distances and travel times felt more inconvenienced and annoyed, and were
19 less satisfied with their commute. Later, Diener and Suh (8) defined and measured QOL based on
20 social and economic components, as well as SWB. These authors also found that QOL is shaped
21 by cultural norms, individual's preferences and experiences. Furthermore, SWB is defined as a
22 reflection of an individual's evaluation of their life in positive terms, which is understood as life
23 satisfaction (9-11). Consequently, satisfaction is one of the components of SWB that influences
24 individuals' overall QOL. Therefore, satisfaction with travel is considered a form of stated SWB,
25 and life satisfaction measures inherently rely on an individual's subjective assessment. The impact
26 of SWB on QOL on both individuals and communities (12) has led to the argument that SWB
27 should be a key indicator in evaluating planning and policy (13; 14). Because commuting is a daily
28 experience for many individuals, it likely contributes to many people's SWB and QOL.

29 The purpose of this study is to analyze the relationship between individuals' satisfaction
30 with their commuting trips and their reported overall life satisfaction. We are specifically
31 interested in understanding the satisfaction with travel component of SWB, and aim to better
32 conceptualize the relationship between satisfaction with travel and reported life satisfaction. This
33 study begins with a literature review that summarizes the existing research on satisfaction and
34 travel. Second, the data is described as is the methodology for the factor-cluster analysis which we
35 use to segment survey respondents by mode and based on like characteristics. Next, the impact of
36 commuting on overall life satisfaction of the resulting clusters is examined. The results of the
37 analysis lead to a discussion about the relationship between trip satisfaction and the impact of
38 commuting, and the study concludes with policy recommendations.

39 LITERATURE REVIEW

40 Travel can influence the SWB and QOL of individuals (15). More specifically, commuting can
41 have negative impacts on home life and work, including having a bad mood at home and increased
42 work related stress (16; 17). Commuters can experience stress during travel, influenced by
43 objective and subjective experiences (18). Increased mobility in urban environments has been
44 associated with higher reported QOL in both young adults (19) and the elderly (20). Studies by
45 transportation researchers have resulted in similar findings that support the impact of satisfaction
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1 with travel on SWB and advocate for the use of SWB as a compliment to other components in
2 evaluating transportation services (21; 22). Establishing the impact that transportation can have on
3 SWB has led researchers to further examine satisfaction through trip purpose and mode.

4 Different aspects of travel influence commuters' perceived satisfaction. For example, trip
5 purpose can have a strong influence on satisfaction, and Bergstad et al. investigated the role of
6 routine activities on life satisfaction. These authors found that positive sentiments were often a
7 result of trips that were for sports, exercise and outdoor activities, and that alternatively, work and
8 school activities were associated with more negative sentiments (23). The negative affect
9 associated with trips to work has been corroborated by other researchers who have similarly found
10 that trips made for work are the most fatiguing and are viewed as less pleasant compared to taking
11 trips for any other purpose (2). Furthermore, work and school trips are associated with more
12 negative moods and are liked less compared to trips that are for socializing, or sports and leisure
13 (4; 24). These results could be due to the fact that commuting is perceived as mandatory and
14 unenjoyable travel in which the commuter has little choice in the decision to travel (1).

15 Other factors influencing commuters' enjoyment of travel and commute related stress is
16 the predictability and length of a trip (3; 25). Commuters that experience a lack of control from
17 delays, congestion and unpredictability during the commute show increased stress (26-28). A less
18 positive mood is associated with driving in larger cities during the peak of peak hours (24). Long
19 commuting lengths have been associated with decreased trip satisfaction (3; 25), lower life
20 satisfaction (29; 30), overall mood (31), and more stress (32). In contrast, many commuters favor
21 moderate commute times rather than short or long times, or eliminating the commute completely
22 (25; 33). This could be because of the time buffer created between work and home (34) and the
23 ability to multi-task (35). Additionally, subgroups of commuters have been found to enjoy their
24 school or work related travel (4) and attitudes about the commute to work can contribute to overall
25 life satisfaction, with positive feelings about the commute leading to positive affect towards life
26 satisfaction (3).

27 The mode used for travel may also impact travel satisfaction. For example, while Legrain,
28 Eluru and El-Geneidy (32) found that the stress of travelling is strongly associated with the mode
29 of the trip, Morris and Guerra (36) found that the relationship between mood, of which stress is a
30 component, and mode is weak. Perhaps this discrepancy is due to the type of survey data used for
31 analysis. The former used data from a Canadian university survey focused on commuting and the
32 latter used survey data that measured how much time Americans spend on different activities.
33 Studies have also found that those who like the mode they use during a trip are more likely to be
34 satisfied with the trip (37), and that people who prefer a certain mode will tend to make choices
35 regarding their home location and self-select to accommodate their travel preferences (38).

36 In assessments of mode on travel satisfaction, walking and cycling have been found to
37 elicit more positive emotion than motorized travel (2; 3; 5; 32; 39). This could be attributed to
38 these active forms of transportation being both relaxing and exciting, as well as a source of physical
39 exercise (27; 39). The high satisfaction of cyclists has been explored and explained through the
40 convenience of the mode and seasonal variation (40). Previous research indicates that bus users
41 are the most unsatisfied mode users (41). Those who travel by bus may experience low trip
42 satisfaction and a negative impact on mood associated with concerns about safety, crowding,
43 delays, and convenience (25; 27; 42; 43). However, taking the bus has the most positive impact
44 on mood when the conditions include short travel times and high access to bus stops (44).
45 Happiness has been found to have a U-shaped or parabolic relationship with access to public
46 transportation. Those with good access and bad access are happy, suggesting that those with poor

1 access are dependent on automobiles (45). In terms of automobile use, those that enjoy their
2 automobile trip do so because of a sense of freedom, control, and reliability (46; 47), while those
3 who do not enjoy their automobile trip feel that driving is mentally tiring, unpleasant, and stressful
4 (2; 27; 32). It has been suggested, through an analysis of budgeted travel time, that automobile
5 drivers experience more unreliability than pedestrians, cyclists and transit users (48). Multi-modal
6 trips are more often seen as unpleasant, and mentally and physically tiring, with multi-modal trips
7 involving public transportation being the most fatiguing (2). Though, those who have used multiple
8 modal options feel less stressed (32).

9 The methods used to measure the relationships between satisfaction and travel include
10 structural equation models (1), linear regression (4; 21), satisfaction with life scales (10; 49; 50),
11 as well as through sentiment analysis of social media posts (45). Pertinent to the current study,
12 clustering techniques have been used to assess the trip satisfaction of pedestrians (40). There are
13 examples of both objective measures (51) and subjective measures (21) of mobility being used in
14 the study of well-being and transportation. The advantages and disadvantages of using subjective
15 and objective measures of satisfaction in transportation research is discussed by Delbosc, who
16 reminds us that satisfaction can mean different things to different people (15). Mokhtarian and
17 Salomon also warn of the complexity of measuring affect in transportation studies and state that
18 respondents of self-reported studies often confuse feelings about activities performed at the
19 destination or during travel when reporting their affect for travel (5).

20 Another challenge associated with studying commuting and life satisfaction is the causal
21 direction. Several studies have analyzed how satisfaction with travel influences SWB or QOL.
22 Olsson et al. and Bergstad et al. operate under the assumption that causal direction is from
23 commute satisfaction to overall happiness (3; 23). This assumption is present in other studies in
24 which the focus on the impact of mobility on perceptions of QOL for the elderly (52) and study
25 the effect of satisfaction with travel on affective and cognitive SWB (21). Olsson et al. do
26 acknowledge that the causal direction could go the other way (3) and overall happiness could
27 influence the perception of trip satisfaction. However, Bergstad et al. (23) assume that the causal
28 direction is from commute satisfaction to overall happiness, and base their assumption on the
29 results of a study by Schimmack that found a stronger association between the influence of domain
30 satisfaction and life satisfaction compared to the influence of life satisfaction on domain
31 satisfaction (53). Accordingly, the present study operates under the first assumption that travel
32 impacts SWB and QOL, similarly to the studies by Olsson et al.(3), Bergstad et al. (21; 23), and
33 Banister and Bowling (52). Furthermore, this study adds to the literature that discusses the impact
34 of commuting on overall life satisfaction by exploring the relationship and identifying patterns
35 based on mode used through a factor-cluster analysis. It is not the intention to confirm this
36 causality, but rather to explore the relationship.

37 38 **DATA**

39 McGill University is located in Montreal, Canada, with approximately 40,000 students and 1,600
40 faculty members and staff. The university has two campuses; one is centrally located in downtown
41 Montreal and the other is a much smaller suburban campus. The data for the study are derived
42 from 2015/2016 the McGill Commuter Survey, which is an online travel behavior survey that was
43 distributed throughout the 2015/2016 school year to faculty, staff and students. In the fall of 2015
44 and the winter of 2016, a total of 8,383 and 8,654 emails were sent to all McGill faculty members
45 and staff, and to one third of the student population. This resulted in a response rate of 35.6%, in
46 which 5,094 surveys were fully completed and 974 were partially completed.

1 The survey captured the commuting habits of faculty, staff and students of McGill, and is
2 therefore focused on utilitarian travel. Respondents were asked questions related to their personal
3 characteristics, including their gender, age, income, home location, and household composition.
4 They were also asked, on a scale of one to ten, to take all things into account and rate their life
5 satisfaction. Other questions were focused on their general commuting habits, including how many
6 years they have been commuting to McGill, how many times a week they commute, how many
7 modes they have access to and which modes they consider reasonable for getting from their home
8 location to McGill. Furthermore, on a five point Likert scale ranging from ‘very unsatisfied’ to
9 ‘very satisfied’ respondents were asked, how satisfied they were with their most recent trip overall,
10 and whether their commuting experience has an impact on their life satisfaction. This question
11 operates under the assumption that trip satisfaction influences overall life satisfaction (3; 21; 23;
12 52). The trip specific questions examined characteristics of the trip, including length, time of day,
13 and the modes used. Respondents were then asked a series of questions about their main mode.
14 This series of questions targeted both the satisfaction with and the importance of certain
15 components of the trip, including infrastructure, safety, efficiency, service quality, parking
16 facilities and comfort.

17 In this study, we include only trips to McGill’s downtown campus. Responses that did not
18 include the respondents’ gender and age were eliminated, as were responses from those under the
19 age of 18 years old. Furthermore, visitors and exchange students were also eliminated because the
20 survey does not indicate the how long these students and visitors were at McGill and their travel
21 behavior may not be indicative of the McGill population as whole. Trips longer than two hours in
22 length were also eliminated in an attempt to remove commuters living outside of Montreal. Finally,
23 due to small sample sizes, any trips made with the McGill intra-campus shuttle, a motorcycle or
24 scooter, taxi, carpool as a passenger, or “other” were eliminated. This resulted in 3,747 trips in
25 which the main modes of transportation were walking, cycling, bus, metro, commuter train or
26 automobile as a driver. The distribution was 841 pedestrians, 293 cyclists, 753 bus users, 1033
27 metro users, 373 train users and 454 automobile drivers. Although public transit is often looked at
28 as one group, a decision was made to keep bus, metro and commuter train users separate in the
29 hope of creating a more nuanced analysis (41).

30 **METHODOLOGY AND RESULTS**

31 **Factor analysis**

32 A factor analysis was conducted for each mode to group similar variables together and identify
33 how variables from the survey questions relate to one another. Using the rotated component matrix,
34 several factors were identified for each mode. Variables for each factor were selected based on a
35 factor loading threshold of .5 or above or -.5 or below. These factors, a description of the variables
36 within each factor, and the factor loadings are shown in Table 1.

37 In order to acknowledge heterogeneity in travel behavior between and within modes, a
38 factor analysis was conducted independently for each mode. Therefore, because survey
39 respondents were asked different questions based on their main mode of transportation for the trip,
40 several mode specific factors resulted from the analysis. For some modes, the analysis revealed
41 similar factors. For example, bus users, metro users and train users all revealed an ‘Importance
42 with Comfort’ and ‘Satisfaction with Comfort’ factor. Furthermore, a factor called the ‘Multi-
43 Modal Measure’ was created. With the exception of cyclists, this measure included the number of
44 modes the respondent has access to and the number of modes used to make their most recent trip.
45 For cyclists, this measure only included the number of modes used in the most recent trip. For

1 drivers, the number of modes the respondent had access to factored with other modes being
2 reasonable options (see Table 1 for details).

3 It is important to note that the respondents were asked mode specific questions based on
4 their main mode. For example, pedestrians were asked about their satisfaction with the quality of
5 sidewalks and cyclists were asked about their satisfaction with the quality of cycle paths. The
6 factors analysis was used because it revealed which components of the trip were important to the
7 different mode users. Therefore, we are not comparing the individual questions. Rather, we are
8 comparing the factors, which contain important trip components for the different mode users.

TABLE 1 Variables Included in Each Factor by Mode

FACTOR		WALKING	CYLCING	BUS	METRO	TRAIN	DRIVE
	VARIABLE FROM SURVEY						
Satisfaction with Safety and Quality							
	Satisfaction with the presence of other pedestrians (1-5)	0.53					
	Satisfaction with the quality of sidewalks (1-5)	0.60					
	Satisfaction with the safety at intersections (1-5)	0.78					
	Satisfaction with the reduced speed of cars (1-5)	0.79					
	Satisfaction with the clarity of crosswalks (1-5)	0.80					
	Satisfaction with the lighting of sidewalks (1-5)	0.83					
Satisfaction with Safety and Infrastructure							
	Satisfaction with the quality of bicycle paths (1-5)		0.75				
	Satisfaction with the signage for bicycles (1-5)		0.78				
	Satisfaction with the reduced speed of cars (1-5)		0.71				
	Satisfaction with the lighting of bicycling paths (1-5)		0.67				
Satisfaction with Service							
	Satisfaction with the length of time spent on bus/metro (1-5)			0.61	0.77		
	Satisfaction with the service reliability (1-5)			0.86	0.79		
	Satisfaction with the consistency (predictability) of time spend on the bus/metro (1-5)			0.79	0.81		
	Satisfaction with the waiting time for the bus/metro (1-5)			0.81	0.80		
	Satisfaction with the length of time spent to reach the bus/metro (1-5)			0.52	0.68		
	Satisfaction with the frequency of service (1-5)			0.81			
Satisfaction with Wait Time and Reliability							
	Satisfaction with the service reliability (1-5)					0.80	
	Satisfaction with the waiting time for the commuter train (1-5)					0.78	
Importance of Safety and Quality							
	Importance of the presence of other pedestrians (1-5)	0.60					
	Importance of the quality of sidewalks (1-5)	0.65					
	Importance of the safety at intersections (1-5)	0.79					
	Importance of the reduced speed of cars (1-5)	0.73					
	Importance of the clarity of crosswalks (1-5)	0.79					
	Importance of the lighting of sidewalks (1-5)	0.65					
Importance of Efficiency							
	Importance of the length of time spent commuting (1-5)	0.81	0.71				
	Importance of the consistency (predictability) of time spent commuting (1-5)	0.77	0.78				
	Importance of the directness of route (1-5)	0.57	0.56				

FACTOR		WALKING	CYLCING	BUS	METRO	TRAIN	DRIVE
	VARIABLE FROM SURVEY						
Importance of Safety and Infrastructure							
	Importance of the quality of bicycle paths (1-5)		0.70				
	Importance of the signage for bicycles (1-5)		0.76				
	Importance of the reduced speed of cars (1-5)		0.73				
	Importance of the lighting of bicycling paths (1-5)		0.74				
Importance of Service							
	Importance of the length of time spent on bus/metro/train (1-5)			0.69	0.81	0.80	
	Importance of the service reliability (1-5)			0.84	0.70	0.66	
	Importance of the consistency (predictability) of time spend on the bus/metro/train (1-5)			0.78	0.85	0.82	
	Importance of the length of time spent to reach the bus (1-5)			0.63	0.73	0.69	
	Importance of the waiting time for bus (1-5)			0.78	0.71	0.73	
	Importance of the frequency of service (1-5)			0.79			
Satisfaction with Parking							
	Satisfaction with the availability of bicycle parking at destination (1-5)		0.89				
	Satisfaction with the quality of bicycle parking at destination (1-5)		0.89				
Importance of Parking							
	Importance of the availability of bicycle parking at destination (1-5)		0.87				
	Importance of the quality of bicycle parking at destination (1-5)		0.88				
Need Shower Facilities							
	Importance of the availability of showers and changing facilities at destination (1-5)		0.60				
	Willingness to pay for shower facilities (Binomial)		0.82				
	Satisfaction with the availability of showers and changing facilities at destination (1-5)		-0.61				
Satisfaction with Comfort							
	Satisfaction with the comfort of seating (1-5)			0.76	0.79	0.86	
	Satisfaction with the comfort of standing space (1-5)			0.85	0.80	0.86	
	Satisfaction with the comfort of being in proximity to others (1-5)			0.84	0.75	0.89	
Importance of Comfort							
	Importance of the comfort of seating on the bus (1-5)			0.79	0.82	0.67	
	Importance of the comfort of standing space on the bus (1-5)			0.88	0.81	0.76	
	Importance of the comfort of being in proximity to others on the bus (1-5)			0.84	0.64	0.73	
Satisfaction and Importance of Parking at Station							
	Satisfaction with the availability of parking close to commuter train station of origin (1-5)					0.52	
	Satisfaction with the cost of parking close to commuter train station of origin (1-5)					0.65	

	Importance of the availability of parking close to commuter train station of origin (1-5)						0.79	
	Importance of the cost of parking close to commuter train station of origin (1-5)						0.78	
FACTOR								
	VARIABLE FROM SURVEY	WALKING	CYLCING	BUS	METRO	TRAIN	DRIVE	
Satisfaction with Parking at Destination								
	Satisfaction with the cost of parking close to destination (1-5)							0.67
	Satisfaction with the availability of parking close to destination (1-5)							0.89
	Satisfaction with the length of time spent looking for parking (1-5)							0.91
	Satisfaction with the consistency (predictability) of time spent looking for parking (1-5)							0.91
Importance of Parking at Destination								
	Importance of the cost of parking close to destination (1-5)							0.79
	Importance of the availability of parking close to destination (1-5)							0.89
	Importance of the consistency (predictability) of time spent looking for parking (1-5)							0.82
Seniority at McGill								
	Status as a member of faculty at McGill (Binomial)	0.76	0.65	0.70	0.64	0.59		0.66
	Number of years at their current position at McGill (Continuous)	0.82	0.80	0.84	0.84	0.83		0.80
	Age	0.87	0.87	0.86	0.85	0.81		0.86
Self-Selected Not to Drive								
	Importance of the cost of parking when moving to your current residence (1-5)	-0.72	-0.56	-0.72	-0.75			
	Importance of being in a location where I wouldn't have to drive when moving to your current residence (1-5)	0.84	0.77	0.67	0.72			
	Importance of being in proximity to public transportation when moving to your current residence (1-5)	0.81	0.81	0.86	0.85			
Self-Selected to be Close to McGill and with Transit Access								
	Importance of being in proximity to public transportation when moving to your current residence (1-5)						0.77	
	Importance of being in close proximity to McGill when moving to your current residence (1-5)						0.77	
Self-Selected to be Close to McGill and with Access to Transit and Parking								
	Importance of being in close proximity to McGill when moving to your current residence (1-5)							0.58
	Importance of being in proximity to public transportation when moving to your current residence (1-5)							0.75
	Importance of the cost of parking when moving to your current residence (1-5)							0.79
Other Modes Viable								
	Driving is a viable option to get to McGill (Binomial)	0.62						
	McGill is within reasonable cycling distance to McGill (Binomial)	0.67						
	Transit is a viable option to get to McGill (Binomial)	0.69						
Short Trip and Chose to be Close to McGill								

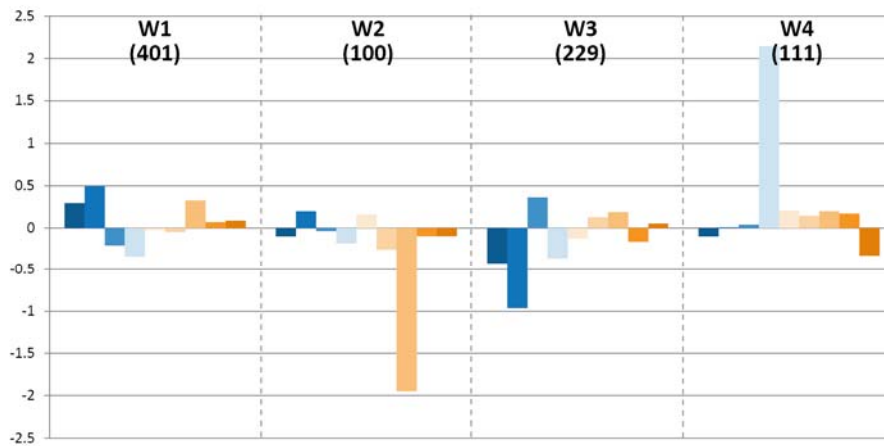
	Importance of being in close proximity to McGill when moving to your current residence (1-5)	0.78					
	Trip length in minutes (Continuous)	-0.68					
Short Trip Where Walking is Viable and Chose to be Close to McGill							
	Trip length in minutes (Continuous)		-0.75				
	McGill is within reasonable walking distance to McGill (Binomial)		0.75				
	Importance of being in close proximity to McGill when moving to your current residence (1-5)		0.57				
FACTOR							
	VARIABLE FROM SURVEY	WALKING	CYLCING	BUS	METRO	TRAIN	DRIVE
Short Trip Where Walking and Cycling are Viable and Chose to be Close to McGill							
	Trip length in minutes (Continuous)			-0.82	-0.68		
	McGill is within reasonable walking distance to McGill (Binomial)			0.70	0.63		
	McGill is within reasonable cycling distance to McGill (Binomial)			0.76	0.67		
	Importance of being in close proximity to McGill when moving to your current residence (1-5)			0.55	0.58		
Short Trip Where Walking and Cycling are Viable							
	Trip length in minutes (Continuous)					-0.49	
	McGill is within reasonable walking distance to McGill (Binomial)					0.72	
	McGill is within reasonable cycling distance to McGill (Binomial)					0.47	
Short Trip and Satisfaction with Trip Length and Predictability							
	Trip length in minutes (Continuous)						-0.67
	Satisfaction with the consistency (predictability) of time spent travelling in the vehicle (1-5)						0.88
	Satisfaction with the length of time spent travelling in the vehicle (1-5)						0.90
Have Access to Other Modes and Walking and Cycling are Viable							
	Number of modes respondent has access to (Continuous)						0.65
	McGill is within reasonable walking distance to McGill (Binomial)						0.64
	McGill is within reasonable cycling distance to McGill (Binomial)						0.70
Multi-Modal Measure							
	Number of modes used in the most recent trip (Continuous)	0.72	0.85	0.74	0.74	0.54	
	Number of modes respondent has access to (Continuous)	0.71		0.74	0.73	0.77	
Frequency of Trip							
	Number of commutes per week (Continuous)	0.69	0.79	0.79	0.78	0.77	0.83
	Full-time status at McGill (Binomial)	0.75	0.78	0.80	0.80	0.75	0.87
VARIANCE		61%	67%	66%	63%	67%	69%

1 **Cluster analysis**

2 The results of the factor analysis for each mode were used to develop a k-means cluster analysis.
3 The purpose of the cluster analysis is to identify heterogeneity within users of the same mode by
4 clustering similar users together. Clustering was tried using three to five groups for each mode.
5 The best number of groupings for each mode was determined based on the characteristics of the
6 factors in each cluster, previous research on mode user typology, and the authors' judgment. The
7 best segmentation was found through four unique clusters for pedestrians, cyclists, bus users,
8 metro users, and drivers, and three for commuter train users, resulting in 23 clusters total. The
9 results of the cluster analysis are presented in Figures 1 and 2. In these figures, each cluster is
10 given a name based on mode. For example, the cyclist clusters are C1, C2, C3 and C4. The number
11 of respondents in each cluster is shown under each name in Figures 1 and 2. Summary statistics
12 for the clusters are presented in Table 2.

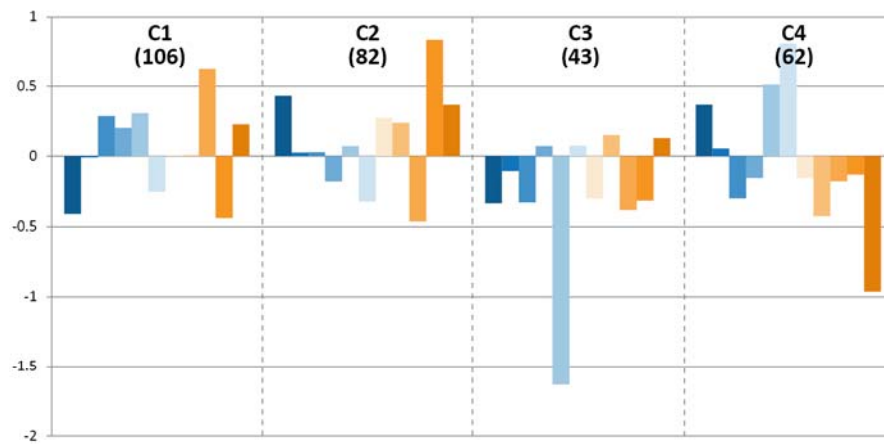
13

PEDESTRIANS



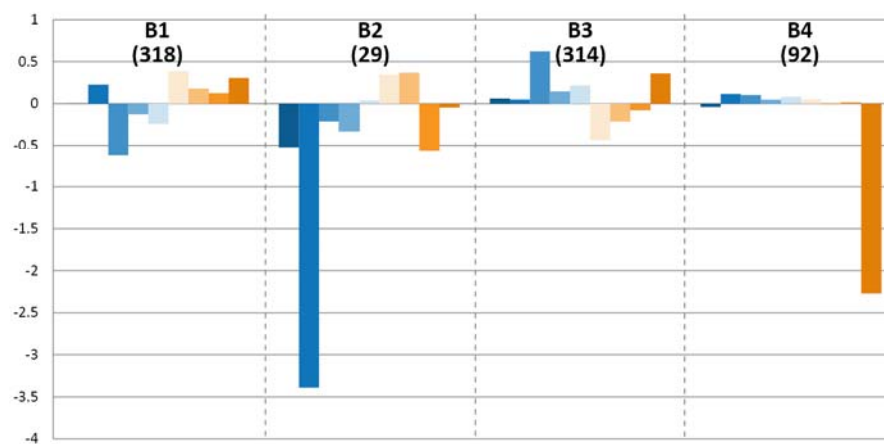
- Satisfaction with Safety and Quality
- Importance of Safety and Quality
- Importance of Efficiency
- Seniority at McGill
- Self-Selected Not to Drive
- Other Modes Viable
- Short Trip and Chose to be Close to McGill
- Multi-Modal Measure
- Frequency of Commute

CYCLISTS



- Satisfaction with Safety and Infrastructure
- Importance of Safety and Infrastructure
- Importance of Efficiency
- Satisfaction with Parking
- Importance of Parking
- Seniority at McGill
- Self-Selected Not to Drive
- Short Trip Where Walking is Viable and Chose to be Close to McGill
- Need Shower Facilities
- Multi-Modal Measure
- Frequency of Commute

BUS USERS



- Satisfaction with Service
- Importance of Service
- Satisfaction with Comfort
- Importance of Comfort
- Seniority at McGill
- Self-Selected Not to Drive
- Short Trip Where Walking and Cycling are Viable and Chose to be Close to McGill
- Multi-Modal Measure
- Frequency of Commute

1

2 **FIGURE 1 Clusters for pedestrians, cyclists and bus users**

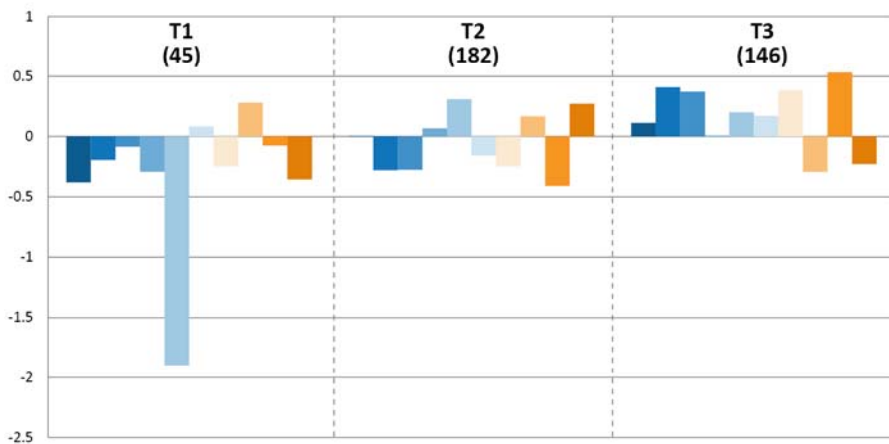
3

METRO USERS



- Satisfaction with Service
- Importance of Service
- Satisfaction with Comfort
- Importance of Cluster
- Seniority at McGill
- Self-Selected Not to Drive
- Short Trip Where Walking and Cycling are Viable and Chose to be Close to McGill
- Multi-Modal Measure
- Frequency of Commute

TRAIN USERS



- Satisfaction with Wait Time and Reliability
- Satisfaction and Importance of Parking at Station
- Satisfaction with Comfort
- Importance of Cluster
- Importance of Service
- Seniority at McGill
- Self-Selected to be Close to McGill and with Transit Access
- Short Trip Where Walking and Cycling are Viable
- Multi-Modal Measure
- Frequency of Commute

DRIVERS



- Satisfaction with Parking at Destination
- Importance of Parking at Destination
- Short Trip and Satisfaction with Trip Length and Predictability
- Seniority at McGill
- Self-Selected to be Close to McGill and with Access to Transit and Parking
- Have Access to Other Modes and Walking and Cycling are Viable
- Frequency of Commute

1

2 **FIGURE 2** Clusters for metro users, commuter train users and drivers.

3

1 **TABLE 2 Cluster Summary Statistics**

PERSONAL CHARACTERISTICS							SATISFACTION			COMMUTE CHARACTERISTICS				TRIP CHARACTERISTICS		
CLUSTER	Age	Gender (% Male)	Income (1-10)	Faculty (%)	Staff (%)	Student (%)	Life Satisfaction (1-10)	Trip Satisfaction (1-5)	Commute Impacts my Life Satisfaction (1-5)	Number of Years at McGill	Commutes Per Week	Full Time (%)	Number of Modes they Have Access To	Trip Length (Minutes)	Left During AM Peak (%)	Number of Modes Used
W1	25.4	41.1	1.5	0.5	9.7	89.8	7.5	4.1	4.2	2.4	5.4	95.5	1.9	16.1	40.4	1.8
W2	32.6	40.0	2.1	3.0	29.0	68.0	7.3	3.9	4.1	4.3	4.5	93.0	1.6	37.3	47.0	1.9
W3	24.6	41.5	1.6	0.9	10.5	88.6	7.3	3.9	4.0	2.5	5.1	98.3	1.8	17.7	37.1	1.6
W4	50.5	52.3	5.8	80.2	19.8	0.0	8.1	4.3	4.6	14.1	4.3	83.8	2.2	29.0	71.2	1.6
C1	34.8	53.8	2.7	17.9	23.6	58.5	7.7	4.1	4.6	3.8	5.0	98.1	2.4	24.1	0.7	1.5
C2	31.6	56.1	2.6	11.0	28.0	61.0	7.7	4.1	4.3	3.9	5.1	98.8	2.4	23.5	0.5	2.9
C3	33.3	65.1	2.9	25.6	16.3	58.1	8.0	4.4	4.5	6.4	4.8	100.0	2.4	22.3	0.5	1.6
C4	44.4	66.1	4.6	53.2	30.6	16.1	8.1	4.0	4.6	9.6	3.5	67.7	2.6	32.6	0.6	1.6
B1	32.6	30.5	2.4	8.5	33.3	58.2	7.4	3.5	4.2	5.0	4.8	100.0	1.9	45.0	62.6	2.7
B2	38.1	58.6	2.5	13.8	34.5	51.7	7.1	2.7	3.6	7.3	4.5	89.7	1.5	44.0	55.2	2.2
B3	40.6	36.0	3.0	16.9	44.9	38.2	7.6	3.6	4.2	9.5	4.8	99.7	1.7	52.4	59.9	2.4
B4	40.1	31.5	2.9	22.8	21.7	55.4	7.5	3.7	4.3	6.2	1.8	38.0	2.1	45.6	39.1	2.5
M1	31.9	45.2	2.1	3.2	24.7	72.0	7.3	3.3	3.7	3.2	4.1	87.1	1.6	44.1	59.1	2.4
M2	31.3	33.4	2.1	0.8	35.6	63.5	7.4	3.5	4.1	3.8	4.8	99.4	1.3	50.1	60.8	2.4
M3	34.3	36.3	2.7	5.6	47.5	46.9	7.5	3.9	4.3	4.8	4.8	98.4	2.2	37.7	70.4	3.0
M4	46.8	38.9	3.9	40.4	31.0	28.6	7.4	3.7	4.2	11.7	2.9	55.7	1.7	43.5	59.1	2.2
T1	47.6	55.6	3.7	13.3	71.1	15.6	7.8	3.6	3.8	12.0	4.4	80.0	1.8	69.6	57.8	2.4
T2	43.4	37.9	3.3	4.4	72.5	23.1	7.5	3.7	4.4	8.6	4.7	97.8	1.5	68.0	59.9	2.4
T3	42.8	41.8	3.9	26.0	50.0	24.0	7.9	3.8	4.4	10.5	4.2	85.6	2.1	70.8	66.4	3.1
D1	46.5	36.8	4.5	36.2	43.2	20.5	7.8	3.7	4.2	11.6	3.5	63.8	1.8	40.4	52.4	1.6
D2	44.6	63.6	5.4	65.2	16.7	18.2	7.6	3.5	4.2	12.2	4.3	90.9	2.5	30.2	71.2	1.9
D3	43.6	39.3	4.0	18.0	48.0	34.0	7.4	3.2	4.0	9.7	3.9	81.3	1.7	50.9	52.0	1.7
D4	47.3	39.6	4.4	24.5	58.5	17.0	7.6	3.1	3.9	10.9	4.4	81.1	1.6	45.9	62.3	1.4
TOTAL	36.5	40.3	2.9	15.6	34.4	50.0	7.5	3.7	4.2	6.7	4.5	89.7	1.9	40.5	56.9	2.2

1 Each cluster corresponds to a similar group of users of the same mode, represented by similar
2 commuting habits, such as travelling frequently, or commuting preferences, such as the satisfaction
3 with service. The following is a description of each cluster that highlights some of the main
4 characteristics.

5 **Walking**

6 *W1*: This cluster is satisfied and concerned with safety and quality. Furthermore, they chose to be
7 close to McGill when choosing their home.

8 *W2*: This group has a long trip length and did not consider being close to McGill as important
9 when choosing their home location.

10 *W3*: This cluster of pedestrians is unsatisfied and unconcerned with safety and quality, but
11 efficiency is important. Other modes are reasonable options but they do not use or have access to
12 modes.

13 *W4*: These commuters are characterized by seniority at McGill and commute infrequently.

14 **Cycling**

15 *C1*: These cyclists are concerned about shower facilities and parking and do not use many modes.

16 *C2*: Cyclists in this cluster are satisfied with safety and infrastructure, use many modes on the trip
17 and report that walking is a reasonable option.

18 *C3*: This group is concerned with safety, infrastructure and efficiency and have a short trip in
19 which they could walk.

20 *C4*: The cyclists in this cluster commute infrequently, have seniority at McGill and have a long
21 trip in which they use few modes.

22 **Bus Users**

23 *B1*: This group is satisfied with service quality, even though it is unimportant to them. They report
24 that walking and cycling are reasonable options and they have access to modes.

25 *B2*: These bus users are unsatisfied with service and comfort. Walking and cycling are viable
26 options for them but they do not have access to nor use many modes.

27 *B3*: These commuters are satisfied with their trip components, which are important to them. They
28 are limited in their modal options.

29 *B4*: This cluster commutes infrequently at less than two times per week, and services are important
30 to them.

31 **Metro Users**

32 *M1*: This cluster is unsatisfied and unconcerned with metro service and walking and cycling are
33 reasonable options. They do not use or have access to many modes.

1 *M2*: They are unsatisfied with service, self-selected to not drive, are limited in their modal options
2 and have low access to other modes.

3 *M3*: These metro users are satisfied with service and unsatisfied with comfort. Walking and
4 cycling are reasonable options for them and they have access to other modes.

5 *M4*: They have seniority status at McGill and commute infrequently.

6 **Train Users**

7 *T1*: These commuters report low satisfaction with several trip components but are unconcerned
8 with service. They have short trips relative to other train users, in which they could walk or cycle
9 and do not have access to many modes.

10 *T2*: This cluster did not self-select when choosing their home, have a short trip relative to other
11 train users in which walking and cycling are options, and have low access.

12 *T3*: These train users are satisfied with trip components, self-selected to be close to McGill with
13 transit access and a long trip. Walking and cycling are not reasonable options but they do have
14 access to modes.

15 **Automobile Drivers**

16 *D1*: This group of drivers is satisfied with their trip components and self-selected to be close to
17 McGill with access to both transit and parking. Walking and cycling are not viable options and
18 they do not have access to modes.

19 *D2*: Walking and cycling are reasonable options for these drivers and they have access to a high
20 number of modes.

21 *D3*: This cluster is unsatisfied and concerned with parking and did not self-select when choosing
22 their home. Walking and cycling are reasonable options and they have access to modes.

23 *D4*: Similar to the above cluster, walking and cycling are reasonable options for these drivers and
24 they have access to a high number of modes.

25 **DISCUSSION**

26 Trip satisfaction and the impact of commuting on life satisfaction were not included in the factor-
27 cluster analysis, so that the various clusters could be plotted against trip satisfaction and the impact
28 of commuting on life satisfaction. Accordingly, Figure 3 demonstrates the relationship between
29 life satisfaction and the impact of commuting on life satisfaction for each cluster. However, while
30 the following analysis addresses the relationship between these two aspects of satisfaction, it is not
31 our intention to confirm causality. Rather, this study is an exploratory analysis of the relationship
32 between commuting and life satisfaction.

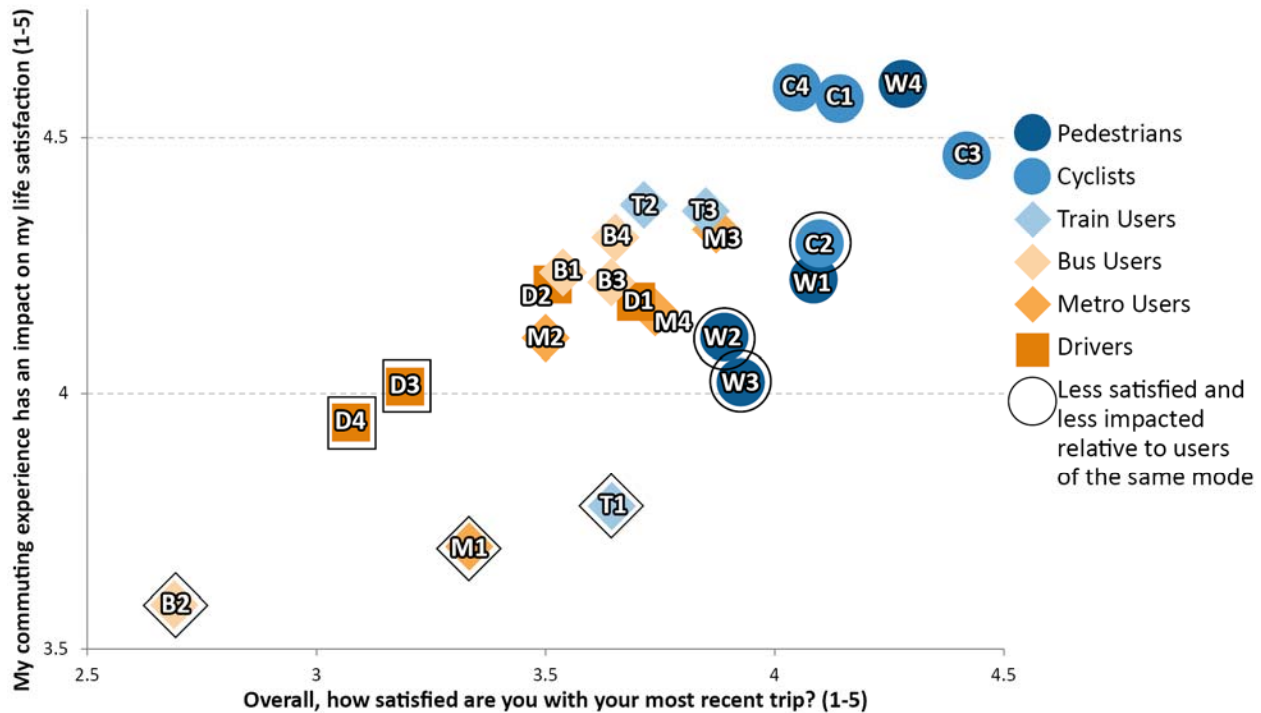


FIGURE 3 Trip Satisfaction and the Impact of Commute on Life Satisfaction.

Trip Satisfaction and the Impact of Commute on Life Satisfaction

Figure 3 demonstrates the relationship between the variables measuring overall trip satisfaction and the impact of commuting on overall life satisfaction. Clusters which on average exhibit high trip satisfaction also show that life satisfaction is highly impacted by commuting. Conversely, clusters with lower trip satisfaction show that commuting does not strongly impact life satisfaction. Furthermore, clusters located in the lower left-hand corner of Figure 3 also exhibit below-average overall life satisfaction on a scale of 1 to 10 (See Table 2). For example, cluster B2 has the lowest reported life satisfaction at 7.1/10, the lowest reported trip satisfaction of 2.7/5, and report their life satisfaction is the least impacted by commuting. On the other end of the spectrum, cluster W4 has the highest life satisfaction, as well as high trip satisfaction, and has a life satisfaction that is one of the most influenced by their commuting experience. This is consistent with previous research that found that happiness with commuting can contribute to overall happiness (3) and suggests that as users' trip satisfaction increases, they may be more likely to report that their life satisfaction is influenced by their commute.

These findings might suggest that commuters who are unsatisfied with their trip are unaware of the impact that commuting has on their overall life satisfaction. Alternatively, the results may be suggesting that those who reported a low trip satisfaction may not want to admit that their commute is impacting their overall life satisfaction. Furthermore, because personality and attitude can play a role in the enjoyment of travel (4; 5), it is possible that personality traits influence the decision to report both low trip satisfaction and low life satisfaction. However, personality traits were not captured in the survey. Therefore, the impact of personality and attitude cannot be examined in this study.

The top right-hand corner of Figure 3 represents high trip satisfaction and high impact of commuting on life satisfaction. This corner is dominated by active transportation clusters, which

1 is consistent with previous findings that report high satisfaction and happiness among cyclists and
2 pedestrians (2; 3; 5; 32; 39). These clusters have been able to derive the enjoyment from their
3 utilitarian work commute that has previously been identified in undirected travel (5). Also similar
4 to previous findings about the dissatisfaction of bus users (41), the least satisfied cluster is B2.

5 **Relatively Less Satisfied Clusters**

6 Overall, Figure 3 demonstrates that active transport users tend to be both more satisfied with their
7 trips and believe that their overall life satisfaction is strongly influenced by their commute. On
8 the other hand, public transit and automobile users tend to be less satisfied overall and their life
9 satisfaction is less influenced by their trip. However, Figure 3 reveals that although there is a
10 general pattern, there are modal clusters that are less satisfied and less impacted by commuting,
11 relative to users of the same mode. More specifically, clusters W2, W3, C2, B2, M1, T1, D3 and
12 D4 were identified as less satisfied and less impacted clusters. These clusters were less satisfied
13 with their trip and their life satisfaction is less impacted by commuting relative to other clusters of
14 the same mode. The clusters that are less satisfied and less impacted by commuting are identified
15 by a black outline in Figure 3. This finding suggests that, while mode choice does influence
16 satisfaction (41), not all users of the same mode are similar. With the exception of C2, a
17 commonality among the less satisfied and less impacted by commuting modal clusters is that the
18 factor measuring access to and use of multiple modes is negative. Therefore, regardless of the
19 mode type, clusters that are less satisfied and less impacted by commuting tend to report having
20 access to and/or using fewer modes than the other clusters using the same mode (Figures 1 and 2).
21 Therefore, clusters with both lower trip satisfaction and a lower impact of commuting on life
22 satisfaction are limited in their travel options, relative to clusters of the same mode. Taking into
23 consideration previous findings that commutes are often viewed as mandatory and unenjoyable
24 (1), these clusters may have low satisfaction because of the lack of control and flexibility in a trip
25 that is viewed as obligatory. This is a significant finding because it emphasizes the importance of
26 giving commuters options that are flexible, reliable and accessible.

27 Commuters in clusters that are less satisfied and less impacted by commuting are not the
28 only respondents with access to fewer modes. There are several clusters with low access even
29 though they are not identified as less satisfied in Figure 3. It is possible that their relatively high
30 satisfaction is explained through self-selection measures, as users in these clusters considered their
31 proximity to McGill or access to transit, when choosing their home location. Through these self-
32 selection strategies, respondents have been able to choose a home that makes their chosen mode a
33 reasonable option. This is likely influencing their trip satisfaction to be relatively high, despite
34 clustering negatively for the factor measuring access to and use of multiple modes. Taking into
35 account previous findings that those who like the mode they are using have higher satisfaction and
36 that people tend to choose home locations where their preferred modes are reasonable options (37;
37 38), the effect of low access appears to be mitigated through self-selection strategies.

38 **Policy Recommendations**

39 The results of this study reveal that those whose life satisfaction is impacted by their commute are
40 relatively more satisfied with their trip, while those whose life satisfaction is less impacted by their
41 commute are less satisfied with their trip. Accordingly, since the life satisfaction of those who are
42 less impacted is lower than those who are impacted, it can be assumed that increasing trip
43 satisfaction could increase the impact of commuting and result in a higher life satisfaction. This is
44 based on respondents with high trip satisfaction also reporting high overall life satisfaction. Based
45 on this analysis, increasing an individual's SWB could be done through improving their commute.

1 Taking into account SWB in assessments of planning and policy (13; 14) should be interpreted as
2 creating policies that improve trip satisfaction, therefore increasing the impact of commuting and
3 life satisfaction, for everyone.

4 The above analysis revealed that there is variation among clusters in terms of trip
5 satisfaction, the impact of commuting on life satisfaction and having access to and using different
6 modes. To increase satisfaction among those who are relatively less satisfied, planners and policy
7 makers should develop strategies that provide access to multi-modal trips that are more reasonable,
8 flexible, and reliable. Additionally, these strategies should encourage multi-modal trips that
9 include more walking and cycling. Strategies for improving multi-modality include developing
10 integrated payment systems for public services such as transit and bicycle-share systems, as well
11 as by integrating bicycle and car parking at transit hubs, and by better integrating pedestrian areas.
12 Other strategies include investing in cycling, pedestrian and transit infrastructure, prioritizing
13 transit connectivity, and creating route findings systems that incorporate multiple modes (54-56).
14 These approaches have been shown to increase mode share for walking and cycling and allow
15 users to express their modal preference. Since those who walk and cycle to work tend to be the
16 most satisfied, with both their trip and their life, increasing the mode share of walking and cycling
17 could have a positive impact on life satisfaction. Additionally, since those who like the mode they
18 use during a trip are more likely to be satisfied with the trip (37), a well-connected multi-modal
19 network would allow commuters to use their preferred mode. Multi-modal trips are sometimes
20 viewed as unpleasant (2), however, strategies to improve the multi-modal experience could
21 encourage the modes that result in high trip satisfaction.

22 **Limitations**

23 Similarly to previous research, this study has shown that commuting can influence life satisfaction
24 (3; 21; 23; 52) and adds to the literature by exploring this relationship through a factor-cluster
25 analysis based on mode. However, commuting is only one of many components that impact a
26 person's SWB. Many other social and economic factors impact life satisfaction and SWB,
27 including income, unemployment, education and quality personal relationships (11; 57-61), but,
28 due to data limitations, these factors could not be included in this study. Additionally, personal
29 factors, including personality and attitude can influence SWB(1). Based on the results of the
30 literature review, as well the findings from the present study, conclusions cannot be drawn that all
31 types of people would benefit from a mode change.

32 Question and sample bias are potential limitations of this study. Diener et al. present a
33 review of the reliability of satisfaction with life scales and find that the results of the scales can be
34 representative of an individual's actual QOL. However, results can be effected by factors such as
35 current mood, question order and method of presentation (62). Therefore, it is important to the
36 note the potential sample bias in the self-reported trip satisfaction and life satisfaction, as self-
37 reported satisfaction and subjective measures rely on the respondents' subjective meaning of
38 satisfaction and trip satisfaction may be biased by the destination itself (5; 15). Additionally, the
39 sample is comprised of faculty, staff and students of a university, meaning the sample is both
40 educated and employed. As noted above, education and employment have a positive impact on
41 satisfaction (57; 59; 60), and it should therefore be expected that the sample would report a higher
42 life satisfaction compared to the general population. Finally, the survey question that asked the
43 respondents to agree or disagree, on a scale of one five, with the statement about commuting
44 impacting life satisfaction was asked immediately after the respondent was asked to rate their trip
45 satisfaction. The close proximity of these two questions in the survey could have induced further
46 response bias.

1 **CONCLUSION**

2 To conclude, previous research has shown that transportation and commuting can have an impact
3 on overall life satisfaction (3; 21; 23; 52). Furthermore, results of this study have revealed that
4 commuters with high trip satisfaction also tend to report that commuting has an impact on their
5 life satisfaction. While the results of this study have revealed relationships between variables,
6 based on the current findings, causality cannot be confirmed. Therefore, in the future, researchers
7 should focus on developing methods to more comprehensively study the impact that commutes
8 have on life satisfaction and focus on assessing causality. While the present study assessed the
9 impact of commuting on life satisfaction, further research could focus on analyzing whether
10 overall QOL and SWB impact the satisfaction with commuting. In addition, researchers studying
11 life satisfaction in different fields should be collaborating with the goal of painting a better overall
12 picture of the factors influencing overall satisfaction and QOL.

13 The findings of the study reveal that there is a relationship between individuals' overall life
14 satisfaction, their reported trip satisfaction, and the perception that trip satisfaction impacts their
15 life satisfaction. Findings suggest that commuters who are satisfied with their trip also report that
16 their commute impacts their life satisfaction. In contrast, less satisfied commuters report a lower
17 association between trip satisfaction and life satisfaction. This suggests that as users' trip
18 satisfaction increases, they may be more likely to report that their life satisfaction is influenced by
19 their commute.

20 This study has added to the literature by exploring the relationship between commuting
21 and overall life satisfaction through modal clusters. Exploring the relationship between trip
22 satisfaction and the impact of commuting on life satisfaction has resulted in policy
23 recommendations that advocate for the building of a well-connected multi-modal transportation
24 network that incorporates active transportation. This would allow commuters to use their preferred
25 mode and diminish the negative impact of being constrained in their modal options.

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27
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34 managing the distribution of the survey to the McGill community.

1 **REFERENCES**

- 2 [1] Ory, D., and P. Mokhtarian. Modeling the structural relationships among short-distance travel
3 amounts, perceptions, affections, and desires. *Transportation Research Part A: Policy and Practice*, Vol.
4 43, No. 1, 2009, pp. 26-43.
- 5 [2] Mokhtarian, P., F. Papon, M. Goulard, and M. Diana. What makes travel pleasant and/or tiring? An
6 investigation based on the French National Travel Survey. *Transportation*, Vol. 42, No. 6, 2015, pp. 1103-
7 1128.
- 8 [3] Olsson, L., T. Gärling, D. Ettema, M. Friman, and S. Fujii. Happiness and satisfaction with work
9 commute. *Social Indicators Research*, Vol. 111, No. 1, 2013, pp. 255-263.
- 10 [4] Ory, D., and P. Mokhtarian. When is getting there half the fun? Modeling the liking for travel.
11 *Transportation Research Part A: Policy and Practice*, Vol. 39, No. 2, 2005, pp. 97-123.
- 12 [5] Mokhtarian, P., and I. Salomon. How derived is the demand for travel? Some conceptual and
13 measurement considerations. *Transportation Research Part A: Policy and Practice*, Vol. 35, No. 8, 2001,
14 pp. 695-719.
- 15 [6] Ettema, D., M. Friman, T. Gärling, L. Olsson, and S. Fujii. How in-vehicle activities affect work
16 commuters' satisfaction with public transport. *Journal of Transport Geography*, Vol. 24, 2012, pp. 215-
17 222.
- 18 [7] Stokols, D., R. Novaco, J. Stokols, and J. Campbell. Traffic congestion, Type A behavior, and stress.
19 *Journal of Applied Psychology*, Vol. 63, No. 4, 1978, p. 467.
- 20 [8] Diener, E., and E. Suh. Measuring quality of life: economic, social and subjective indicators. *Social*
21 *Indicators Research*, Vol. 40, 1997, pp. 189-216.
- 22 [9] Diener, E. Subjective well-being. *Psychological Bulletin*, Vol. 95, 1984, pp. 276-302.
- 23 [10] Diener, E., R. Emmons, R. Larsen, and S. Griffin. The satisfaction With Life Scale. *Journal of*
24 *Personality Assessment*, Vol. 49, 1985, pp. 71-75.
- 25 [11] Diener, E., R. Suh, and H. Smith. Subjective well-being: three decades of progress. *Psychological*
26 *Bulletin*, Vol. 125, 1999, pp. 276-302.
- 27 [12] Diener, E., S. Oishi, and R. Lucas. Personality, culture, and subjective well-being: Emotional and
28 cognitive evaluations of life. *Annual review of psychology*, Vol. 54, No. 1, 2003, pp. 403-425.
- 29 [13] Stanley, J., and J. Stanley. Public transport and social policy goals. *Road & Transport Research: A*
30 *Journal of Australian and New Zealand Research and Practice*, Vol. 16, No. 1, 2007, p. 20.
- 31 [14] Cao, J., and J. Zhang. Built environment, mobility, and quality of life. *Travel behaviour and society*,
32 Vol. 5, 2016, pp. 1-4.
- 33 [15] Delbosc, A. The role of well-being in transport policy. *Transport Policy*, Vol. 23, 2012, pp. 25-33.
- 34 [16] Wener, R., G. Evans, and P. Boatley. Commuting stress: Psychophysiological effects of a trip and
35 spillover into the workplace. *Transportation Research Record: Journal of the Transportation Research*
36 *Board*, No. 1924, 2005, pp. 112-117.
- 37 [17] Novaco, R., W. Kliewer, and A. Broquet. Home environmental consequences of commute travel
38 impedance. *American Journal of Community Psychology*, Vol. 19, No. 6, 1991, pp. 881-909.
- 39 [18] Novaco, R., D. Stokols, and L. Milanese. Objective and subjective dimensions of travel impedance as
40 determinants of commuting stress. *American Journal of Community Psychology*, Vol. 18, No. 2, 1990, pp.
41 231-257.
- 42 [19] Xiong, Y., and J. Zhang. Effects of land use and transport on young adults' quality of life. *Travel*
43 *behaviour and society*, Vol. 5, 2016, pp. 37-47.
- 44 [20] van den Berg, P., A. Kemperman, B. de Kleijn, and A. Borgers. Ageing and loneliness: the role of
45 mobility and the built environment. *Travel behaviour and society*, Vol. 5, 2016, pp. 48-55.

- 1 [21] Bergstad, C., A. Gamble, T. Gärling, O. Hagman, M. Polk, D. Ettema, M. Friman, and L. Olsson.
2 Subjective well-being related to satisfaction with daily travel. *Transportation*, Vol. 38, No. 1, 2011, pp. 1-
3 15.
- 4 [22] Ettema, D., T. Gärling, L. Olsson, and M. Friman. Out-of-home activities, daily travel, and subjective
5 well-being. *Transportation Research Part A: Policy and Practice*, Vol. 44, No. 9, 2010, pp. 723-732.
- 6 [23] Bergstad, C., A. Gamble, O. Hagman, M. Polk, T. Gärling, D. Ettema, M. Friman, and L. Olsson.
7 Influences of affect associated with routine out-of-home activities on subjective well-being. *Applied*
8 *Research in Quality of Life*, Vol. 7, No. 1, 2012, pp. 49-62.
- 9 [24] Morris, E., and J. Hirsch. Does rush hour see a rush of emotions? Driver mood in conditions likely to
10 exhibit congestion. *Travel behaviour and society*, Vol. 5, 2016, pp. 5-13.
- 11 [25] Ory, D., P. Mokhtarian, L. Redmond, I. Salomon, G. Collantes, and S. Choo. When is commuting
12 desirable to the individual? *Growth and Change*, Vol. 35, No. 3, 2004, pp. 334-359.
- 13 [26] Gottholmseder, G., K. Nowotny, G. Pruckner, and E. Theurl. Stress perception and commuting.
14 *Health economics*, Vol. 18, No. 5, 2009, pp. 559-576.
- 15 [27] Gatersleben, B., and D. Uzzell. Affective appraisals of the daily commute comparing perceptions of
16 drivers, cyclists, walkers, and users of public transport. *Environment and behavior*, Vol. 39, No. 3, 2007,
17 pp. 416-431.
- 18 [28] Evans, G., R. Wener, and D. Phillips. The morning rush hour predictability and commuter stress.
19 *Environment and behavior*, Vol. 34, No. 4, 2002, pp. 521-530.
- 20 [29] Choi, J., J. Coughlin, and L. D'Ambrosio. Travel time and subjective well-being. *Transportation*
21 *Research Record: Journal of the Transportation Research Board*, No. 2357, 2013, pp. 100-108.
- 22 [30] Stutzer, A., and B. Frey. Stress that doesn't pay: The commuting paradox. *The Scandinavian Journal*
23 *of Economics*, Vol. 110, No. 2, 2008, pp. 339-366.
- 24 [31] Morris, E., and E. Guerra. Are we there yet? Trip duration and mood during travel. *Transportation*
25 *Research Part F: Traffic Psychology and Behaviour*, Vol. 33, 2015, pp. 38-47.
- 26 [32] Legrain, A., N. Eluru, and A. El-Geneidy. Am stressed, must travel: The relationship between mode
27 choice and commuting stress. *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 34,
28 2015, pp. 141-151.
- 29 [33] Redmond, L., and P. Mokhtarian. The positive utility of the commute: modeling ideal commute time
30 and relative desired commute amount. *Transportation*, Vol. 28, No. 2, 2001, pp. 179-205.
- 31 [34] Jain, J., and G. Lyons. The gift of travel time. *Journal of Transport Geography*, Vol. 16, No. 2, 2008,
32 pp. 81-89.
- 33 [35] Ettema, D., and L. Verschuren. Multitasking and value of travel time savings. *Transportation*
34 *Research Record: Journal of the Transportation Research Board*, 2007.
- 35 [36] Morris, E., and E. Guerra. Mood and mode: does how we travel affect how we feel? *Transportation*,
36 Vol. 42, No. 1, 2015, pp. 25-43.
- 37 [37] Choo, S., G. Collantes, and P. Mokhtarian. Wanting to travel, more or less: exploring the
38 determinants of the deficit and surfeit of personal travel. *Transportation*, Vol. 32, No. 2, 2005, pp. 135-
39 164.
- 40 [38] Bhat, C., and J. Guo. A comprehensive analysis of built environment characteristics on household
41 residential choice and auto ownership levels. *Transportation Research Part B: Methodological*, Vol. 41,
42 No. 5, 2007, pp. 506-526.
- 43 [39] Duarte, A., C. Garcia, G. Giannarakis, S. Limão, A. Polydoropoulou, and N. Litinas. New approaches in
44 transportation planning: happiness and transport economics. *NETNOMICS: Economic Research and*
45 *Electronic Networking*, Vol. 11, No. 1, 2010, pp. 5-32.
- 46 [40] Willis, D., K. Manaugh, and A. El-Geneidy. Uniquely satisfied: Exploring cyclist satisfaction.
47 *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 18, 2013, pp. 136-147.

- 1 [41] St-Louis, E., K. Manaugh, D. van Lierop, and A. El-Geneidy. The happy commuter: A comparison of
2 commuter satisfaction across modes. *Transportation Research Part F: Traffic Psychology and Behaviour*,
3 Vol. 26, 2014, pp. 160-170.
- 4 [42] Stradling, S., J. Anable, and M. Carreno. Performance, importance and user disgruntlement: A six-
5 step method for measuring satisfaction with travel modes. *Transportation Research Part A: Policy and*
6 *Practice*, Vol. 41, No. 1, 2007, pp. 98-106.
- 7 [43] Ory, D. T., P. L. Mokhtarian, L. S. Redmond, I. Salomon, G. O. Collantes, and S. Choo. When is
8 commuting desirable to the individual? *Growth and Change*, Vol. 35, No. 3, 2004, pp. 334-359.
- 9 [44] Ettema, D., T. Gärling, L. Eriksson, M. Friman, L. Olsson, and S. Fujii. Satisfaction with travel and
10 subjective well-being: Development and test of a measurement tool. *Transportation Research Part F:*
11 *Traffic Psychology and Behaviour*, Vol. 14, No. 3, 2011, pp. 167-175.
- 12 [45] Guo, W., N. Gupta, G. Pogrebna, and S. Jarvis. Understanding happiness in cities using Twitter: jobs,
13 children and transport. 2016.
- 14 [46] Mann, E., and C. Abraham. The role of affect in UK commuters' travel mode choices: An
15 interpretative phenomenological analysis. *British Journal of Psychology*, Vol. 97, No. 2, 2006, pp. 155-
16 176.
- 17 [47] Gardner, B., and C. Abraham. What drives car use? A grounded theory analysis of commuters'
18 reasons for driving. *Transportation Research Part F: Traffic Psychology and Behaviour*, Vol. 10, No. 3,
19 2007, pp. 187-200.
- 20 [48] Loong, C., and A. El-Geneidy. It's a Matter of Time: An Assessment of Additional Time Budgeted for
21 Commuting Across Modes. In *Transportation Research Board 95th Annual Meeting*, 2016.
- 22 [49] Cao, X. How does neighborhood design affect life satisfaction? Evidence from Twin Cities. *Travel*
23 *behaviour and society*, Vol. 5, 2016, pp. 68-76.
- 24 [50] Ettema, D., and M. Schekkerman. How do spatial characteristics influence well-being and mental
25 health? Comparing the effect of objective and subjective characteristics at different spatial scales. *Travel*
26 *behaviour and society*, Vol. 5, 2016, pp. 56-67.
- 27 [51] Stanley, J., D. Hensher, J. Stanley, and D. Vella-Brodrick. Mobility, social exclusion and well-being:
28 Exploring the links. *Transportation Research Part A: Policy and Practice*, Vol. 45, No. 8, 2011, pp. 789-
29 801.
- 30 [52] Banister, D., and A. Bowling. Quality of life for the elderly: The transport dimension. *Transport*
31 *Policy*, Vol. 11, No. 2, 2004, pp. 105-115.
- 32 [53] Schimmack, U. The structure of subjective well-being. *The science of subjective well-being*, 2008, pp.
33 97-123.
- 34 [54] Terveen, L. Bike, bus, and beyond: extending cyclopath to enable multi-modal routing. 2013.
- 35 [55] Henao, A., D. Piatkowski, K. Luckey, K. Nordback, W. Marshall, and K. Krizek. Sustainable
36 transportation infrastructure investments and mode share changes: A 20-year background of Boulder,
37 Colorado. *Transport Policy*, Vol. 37, 2015, pp. 64-71.
- 38 [56] Mishra, S., T. Welch, and M. Jha. Performance indicators for public transit connectivity in multi-
39 modal transportation networks. *Transportation Research Part A: Policy and Practice*, Vol. 46, No. 7,
40 2012, pp. 1066-1085.
- 41 [57] Clark, A., and A. Oswald. Satisfaction and comparison income. *Journal of public economics*, Vol. 61,
42 No. 3, 1996, pp. 359-381.
- 43 [58] Ferrer-i-Carbonell, A. Income and well-being: an empirical analysis of the comparison income effect.
44 *Journal of public economics*, Vol. 89, No. 5, 2005, pp. 997-1019.
- 45 [59] Helliwell, J. How's life? Combining individual and national variables to explain subjective well-being.
46 *Economic modelling*, Vol. 20, No. 2, 2003, pp. 331-360.
- 47 [60] Delbosch, A., and G. Currie. Exploring the relative influences of transport disadvantage and social
48 exclusion on well-being. *Transport Policy*, Vol. 18, No. 4, 2011, pp. 555-562.

1 [61] Myers, D. The funds, friends, and faith of happy people. *American psychologist*, Vol. 55, No. 1, 2000,
2 p. 56.

3 [62] Diener, E., R. Inglehart, and L. Tay. Theory and validity of life satisfaction scales. *Social Indicators*
4 *Research*, Vol. 112, No. 3, 2013, pp. 497-527.

5