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Post-commute self-assessed work performance

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ABSTRACT

Commuting can have immediate and long-term impacts on employees' behaviour and motivations at work. This study focuses on the self-assessed impact of commute mode on multiple aspects of work performance, namely energy and productivity at work, and punctuality in getting to work. Using large-scale national data (N = 6,671) from the Canadian Mobility Survey conducted in Fall 2024 across 12 metropolitan regions, we conduct weighted logistic regression models that investigate each self-assessed work performance aspect. We use three data subsets based on region population size (large, mid-size, and small). Our models account for main travel mode, commute duration, motivations for mode choice, and sociodemographic factors. For all three subsets, we find that active commuters (pedestrians and cyclists) are the most likely to express positive impacts of commuting on energy and productivity at work, followed by car users. Meanwhile, bus, streetcar, LRT, and BRT users are the least likely to express such results. Car users have a higher likelihood of expressing punctuality to work compared to pedestrians and transit users in all three subsets. Longer commute durations are associated with negative impacts on all three work performance measures, especially punctuality.

Takeaway for practice: Our study underscores that commuting is not a neutral transition between home and work but an influential factor in work performance. Investment in infrastructure that supports active transport and high-quality transit that is fast and comfortable can promote positive performance at work.

1. Introduction

Despite the rising prominence of teleworking and hybrid work (Kellermann et al., 2022), commuting remains a key part of daily life that shapes how people structure and experience their routines. As of 2024, there are 16.5 million commuters in Canada (Statistics Canada, 2024). Commuting has been theorized as a trade-off between two variables: labour and housing, with individuals optimizing their commute by balancing wages and housing costs to maximize their utility (Alonso, 1965). This theory suggests that longer commute times could be entirely compensated for by lower housing prices. Recently, it has been recognized that the full costs (or benefits) of commuting can extend much further, affecting individuals' perceptions of general well-being (Stutzer & Frey, 2008) and performance at work (Li et al., 2024; Loong et al., 2017; Ma & Ye, 2019).

Long commutes can strain work-life balance and are associated with lower organizational commitment (Emre & De Spiegeleare, 2021). Heavy commute burdens can lead employees to reduce their work effort and have higher rates of absenteeism (Ma & Ye, 2019; Wang et al., 2021), carrying significant economic consequences. Absenteeism was estimated to have a direct cost of $16.6 billion to the Canadian economy in 2012 (Stewart, 2013). Acknowledging the importance of the commute trip on the overall economy and on daily lives, many studies have explored commute satisfaction (Chatterjee et al., 2020; Liu et al., 2022) and stress (Legrain et al., 2015). Lim et al. (2024) proposed a model understanding the determinants and impacts of commuting and its relationship with several aspects of life through the Pre-commute/In-commute/Post-commute (PIP) model. The model hypothesizes that commuting has immediate and long-term impacts that can affect work and personal outcomes like family life and health. Our study contributes to the literature by expanding on the work-related post-commute impacts beyond the notions of satisfaction and stress.

This study examines the self-assessed impact of commute mode choice on work performance using large-scale data from the Canadian Mobility Survey, a nationwide survey conducted in 2024 across 12 Canadian regions. The survey collects data on participants' commuting

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behaviour and perceived impacts on work performance, reasoning behind mode choice, travel attitudes, and socioeconomic characteristics. We categorize the 12 regions into three large (N = 2,109), three mid-size (N = 1,923), and six small regions (N = 2,639). For each group, we run three logistic regression models to explore the factors that are associated with positive impacts on energy at work, productivity at work, and punctuality in getting to work. Understanding the influence of commuting on work performance can underpin strategies targeted at improving employee performance and well-being, which has cascading effects on organizational efficiency and broader economic outcomes.

2. Literature review

2.1. Commute satisfaction

Commuting is typically considered to be unpleasant. Mood tends to be lower during the commute compared to other daily activities (Chatterjee et al., 2020). Experiences with congestion, crowding, and unpredictability can induce stress during travel (Legrain et al., 2015). Impedances or unsatisfactory travel experiences during the commute can deplete time, energy, and emotional resources, reducing individuals' capacity to manage responsibilities at work or at home (Lim et al., 2024).

Commute duration is an important determinant of commute satisfaction (Liu et al., 2022). Longer commute times have been associated with higher stress (Gimenez-Nadal & Molina, 2019; Legrain et al., 2015; Sposato et al., 2012) and increased worker strain (Clark et al., 2020). Yet, Redmond and Mokhtarian (2001) found that most people have a non-zero optimum commute time, suggesting that people can derive some positive benefits from their commute, such as a buffer between home and work or the ability to use the time productively. The relationship between duration and satisfaction may be mode-specific. Heinen et al. (2011) found that longer commuting distances by cycling were associated with more positive attitudes towards the mode, contesting the blanket notion that longer travel durations are detrimental to satisfaction. However, De Vos et al. (2022) suggest that differences in commute satisfaction between active commuters and public transit commuters can be explained by shorter versus longer commutes, implying that travel duration may be a more important determinant of commute satisfaction than travel mode.

Nonetheless, the experiential qualities of different modes are relevant to cognitive and affective evaluations of commute trips that contribute to overall satisfaction (Ettema et al., 2011). Research consistently shows that active commuters are more satisfied with their commutes than car or transit users (Handy & Thigpen, 2019; Smith, 2017; St-Louis et al., 2014; Ye & Titheridge, 2017) and are able to derive positive well-being benefits such as physical health benefits (Heinen et al., 2011; Humphreys et al., 2013) and greater life satisfaction (Fordham et al., 2018). However, car users can also derive benefits from their travel such as feelings of freedom and control or possessing a status-symbol (Ory & Mokhtarian, 2005).

The ability to derive utility from the travel experience itself may be a result of subjective attitudes, as preferences driven by personal motivations towards a mode can play a dominant role in mode choice, and therefore travel satisfaction, with those with positive attitude towards mode used and travel in general being more satisfied (St-Louis et al., 2014; Ye & Titheridge, 2017). Manaugh and El-Geneidy (2013) found drastic differences in travel patterns and satisfaction levels among commuters who walk based on their motivations for their mode choice. Those who reported valuing exercise and environmental awareness tended to walk farther and were more satisfied, while satisfaction for those who valued convenience, proximity, and cost was negatively associated with distance. Limitations in travel options—for example, due to limited public transit routes or schedules or not having a drivers' license or car—might result in people engaging in a certain mode by necessity rather than choice, and these dissonant travelers tend to have lower satisfaction levels (De Vos, 2018).

2.2. Spillover effects of commuting

Evidence increasingly suggests that the experience of commuting can "spill over" into different domains of subjective well-being including health and work (Chatterjee et al., 2020; Deng et al., 2024). Lim et al. (2024) propose the Pre-commute/In-commute/Post-commute (PIP) model for understanding how the commute can be resource depleting or replenishing within the Conservation of Resources (COR) framework. In the pre-commute stage, underlying personal variables can affect how individuals experience their commutes, while different in-commute characteristics like predictability, crowding or congestion, and physical or mental demands can affect whether one experiences their commute as energizing, relaxing, or restorative versus stressful and resource-depleting. The experience of the commute can have lingering impacts on work performance and personal outcomes like family life and health—which subsequently affect the pre-commute state—creating potential for a negative feedback loop.

Loong et al. (2017) investigated how the daily commutes of

Fig. 1. Regions surveyed in the CMS.

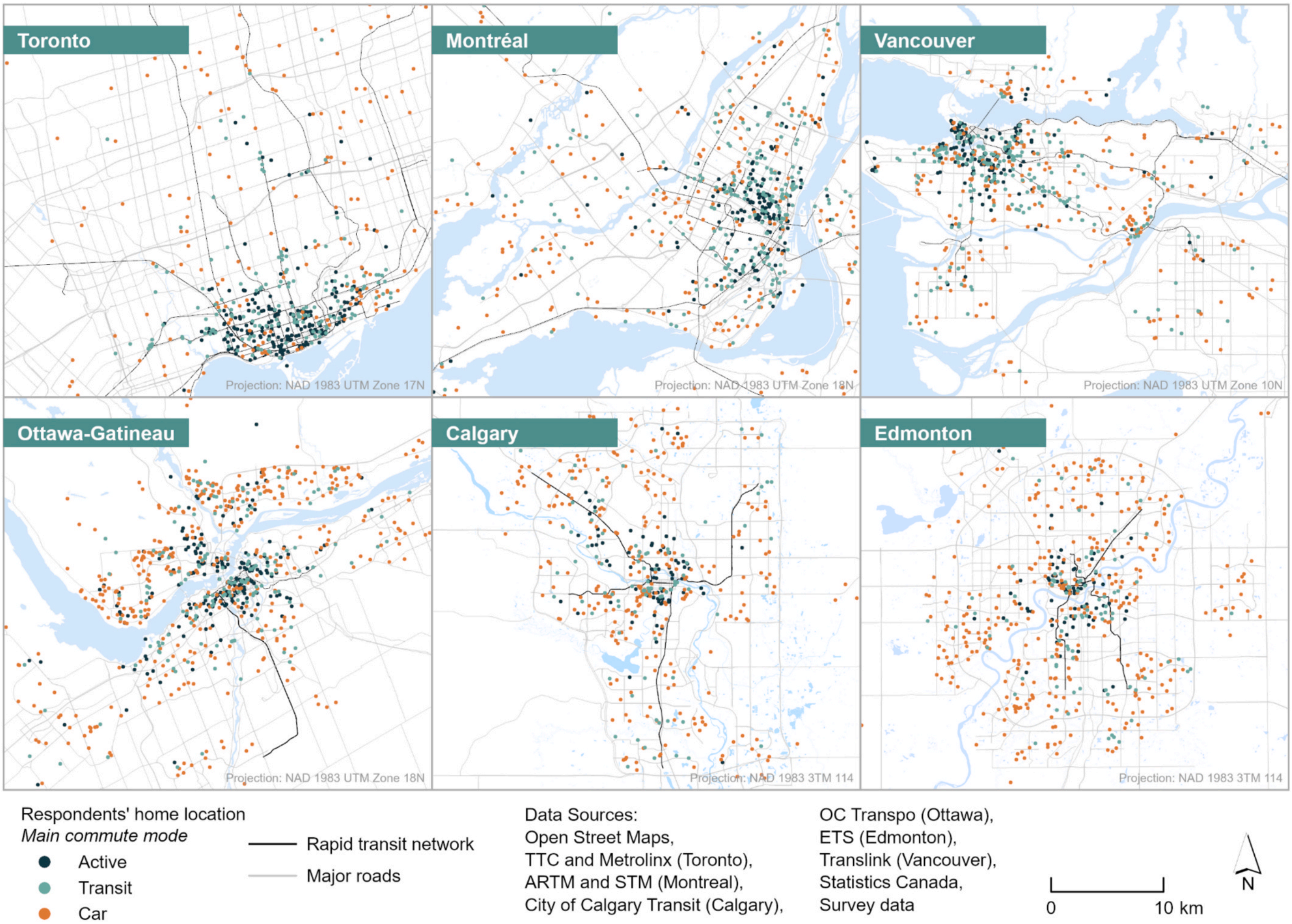

Fig. 2. Home location and main commute mode of respondents in large and mid-size regions. Home location and main commute mode of respondents in small regions.

university students, staff, and faculty affected their punctuality and feelings of being energized at work or school. They found that cyclists had the highest odds of feeling energized while drivers and public transit users had similarly low odds. Cyclists also had the highest punctuality whereas drivers and bus users were least likely to be punctual. While the sample was relatively limited in its scope of students and employees at a downtown campus in a dense metropolis, the positive benefits of active commuting on work performance have been corroborated in both transport and occupational health research. A study of employees at an organization in the United Kingdom found that employees who participated in a behaviour change intervention to switch to e-bikes for commuting reported higher positive affect and more productive organizational behaviour compared to employees who continued with their regular passive commuting behaviour (Page & Nilsson, 2017).

Commute distance has been shown to have a direct impact on worker performance. Ma and Ye (2019) examined the effects of commute mode choice and distance in three Australian regions on employee productivity which was measured by absenteeism and a work performance measure adapted from the World Health Organization Health and Work Performance Questionnaire (HPQ). Using structural equation modelling, they found that mode choice and distance influenced absenteeism and work performance through their effects on commute satisfaction and personal health, though, after controlling for the indirect effects, longer commute distance retained a direct effect on higher absenteeism.

Our study addresses a gap in the literature by examining post-commute impacts on self-assessed work performance through commute-specific questions, rather than relying on universal measures such as the WHO performance questionnaire, which do not directly capture the direct impact of commute mode. Our study also uses self-reported ratings of the impact of commute mode on work performance, contributing to the understanding of how subjective appraisals of energy, productivity, and punctuality are shaped by commute characteristics.

3. Data

This research uses data from the Canadian Mobility Survey (CMS), a bilingual online transport survey conducted in Fall 2024 in 12 Census Metropolitan Regions (CMA): Toronto, Montréal, Vancouver, Ottawa-Gatineau, Calgary, Edmonton, Québec, Winnipeg, Hamilton, Halifax, Victoria, and Saskatoon (Fig. 1). The CMS collects data on commuting behaviour and impacts on work performance, reasoning behind mode choice, travel attitudes, and socioeconomic characteristics. Recruitment was performed using a variety of strategies as recommended by Dillman et al. (2014) including online social media advertisement, the distribution of flyers, radio interviews, and a public opinion company.[1]

A thorough multi-step data-cleaning procedure was applied to the survey data. The cleaning process used exclusion criteria based on

[1] Consent was obtained from the McGill Research and Ethics Board prior to conducting the survey (certificate # 99–0719).

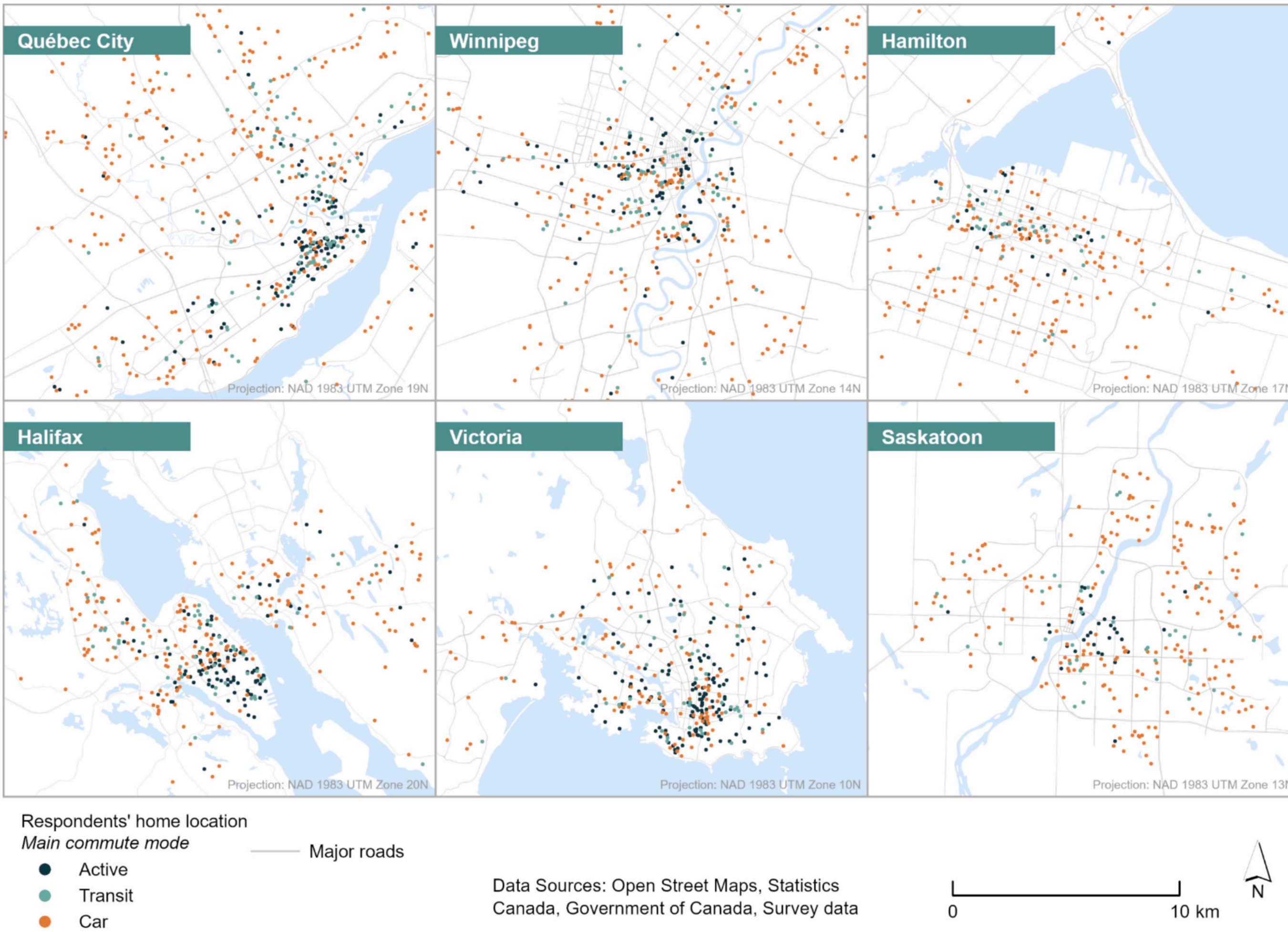

Fig. 2. (*continued*).

participants' IP and e-mail addresses, location pins of home, work and/or school, the time it took to complete the survey, age above 90 years old, commute mode, and frequency of weekly travel (Negm et al., 2025). Only participants who reported a work commute trip (full- and part-time workers that did not exclusively telework) were retained. Respondents reported the modes used in their most recent commute trip. In the case of multiple modes, they identified their main mode as the one they traveled farthest in. Participants identified the factors that were important in choosing their main commute mode (e.g., shorter travel time, more comfortable, physical/mental health). Using the home and work locations and the main mode of travel, we retrieve travel times using a Google Maps API. Reported commute travel times were retrieved through questions about departure time from home and arrival time at work at 5-minute intervals. We use reported travel times as a better representation of the real-world experience (Koslowsky, 1997; Valero et al., 2025). However, calculated travel times were important to set an exclusion criteria where the discrepancy between the reported and calculated travel time was 30 min or more, or if their reported travel time was greater than 105 min.

To ensure statistical rigor, respondents were excluded for a given mode if fewer than 30 reported using it in their region (e.g., Saskatoon had 18 cyclists, who were excluded). Light rail transit (LRT) and bus rapid transit (BRT) were combined into a single mode category, and the bus category includes streetcar users. This resulted in a final sample of 6,671 commuters across 12 metropolitan regions. Due to heterogeneity of transit services offered across these regions, we chose to split the sample according to region size and transit modes offered. The three subsamples are for large regions with a sufficient number (more than 30 in each region) of subway[2] users (Toronto, Montréal, and Vancouver), mid-size regions with a sufficient number of LRT or BRT users (Calgary, Ottawa-Gatineau, Edmonton), and smaller regions where transit users are exclusively bus users (Québec, Winnipeg, Halifax, Victoria, Hamilton, and Saskatoon). The final subsample sizes used in analysis are 2,109 respondents in large regions, 1,923 respondents in mid-sized regions, and 2,639 respondents in small regions (Fig. 2).

4. Methods

We examined work performance using self-rated questions about energy and productivity at work and punctuality to work on a five-point Likert scale from "*very negatively*" to "*very positively*". Respondents were asked: "How does travelling to work using the selected mode(s) impact the following aspects?" For each outcome variable, we ran three logistic regressions, stratified by metropolitan region size, resulting in a total of nine models. Although ordered logit and probit models are often used to examine well-being and satisfaction questions when data is ordinal in nature (Fielbaum & Tirachini, 2021; Mattson et al., 2021), several issues led us to adopt a binary approach instead: the small sample size within the most negative category, a lack of statistical difference between "negatively" and "no impact" thresholds in initial estimations, and violations of the parallel slopes assumption for key predictor variables. In turn, we categorized the outcome variables as binary by grouping "*very negatively,*" "*negatively,*" and "*no impact*" as 0, and "*positively*" and "*very*

[2] In this study, subway includes the SkyTrain that serves Metro Vancouver.

Table 1
Subsample descriptive statistics (unweighted).

	Large (N = 2,109)		Mid-size (N = 1,923)		Small (N = 2,639)	
Energy at work (positive)	1,183	56.1%	1,021	53.1%	1,493	56.6%
Productivity at work (positive)	1,070	50.7%	950	49.4%	1,348	51.1%
Punctuality in getting to work (positive)	1,390	65.9%	1,320	68.6%	1,843	69.8%
Independent variables						
Age	40.9	12.5	41.1	12.1	41.9	12.8
Gender (women)	1,127	53.4%	1,181	61.4%	1,592	60.3%
Income						
Less than $60 k	315	14.9%	268	13.9%	528	20.0%
$60 k to $120 k	761	36.1%	703	36.6%	1,036	39.3%
More than $120 k	1,033	49.0%	952	49.5%	1,075	40.7%
Days teleworking	1.3	1.5	1.1	1.4	1.0	1.4
Main commute mode						
Car	893	42.3%	1,155	60.1%	1,657	62.8%
Bicycle	358	17.0%	245	12.7%	310	11.7%
Walk	221	10.5%	166	8.6%	295	11.2%
Bus or streetcar	229	10.9%	222	11.5%	377	14.3%
Subway	408	19.3%				
LRT or BRT			135	7.0%		
Commute duration (mins)	35.2	18.9	30.5	15.8	26.0	14.2
Reasons for mode choice						
Shorter travel time	1,419	67.3%	1,264	65.7%	1,773	67.2%
More comfortable	844	40.0%	844	43.9%	1,141	43.2%
Physical/mental health	859	40.7%	727	37.8%	1,039	39.4%
Cheaper	857	40.6%	679	35.3%	851	32.2%
Better for environment	636	30.2%	454	23.6%	636	24.1%
Other modes don't go where I need to go	338	16.0%	323	16.8%	485	18.4%
Able to be productive	250	11.9%	210	10.9%	288	10.9%
Region						
Montréal	746	35.40%				
Toronto	684	32.40%				
Vancouver	679	32.20%				
Ottawa-Gatineau			870	45.2%		
Edmonton			569	29.6%		
Calgary			484	25.2%		
Québec					652	24.7%
Winnipeg					538	20.4%
Halifax					460	17.4%
Victoria					372	14.1%
Hamilton					314	11.9%
Saskatoon					303	11.5%
	n (%); mean (SD)					

positively" as 1.

Due to the regional variation of respondents, we tested a multi-level modeling approach which is commonly used when geographic difference adds important context that would be otherwise lost (Jones, 1991). The random intercept allows for baseline outcomes to vary across groups, i.e. regions. However, in all nine models, intraclass correlation coefficient (ICC) and intercept variance (τ00) were either nonexistent or negligible, as grouping the sample by region size and transit services offered likely already accounted for the most relevant regional differences. We proceeded with weighted logistic regression models which accounted for any sampling bias in the clean survey data. The weighting is calculated for all valid responses using the anesrake R package (Pasek, 2018), which follows an iterative ranking process (DeBell & Krosnick, 2009). The weights were calculated to match the census-tract information of age, income, gender, and commute mode obtained from Statistics Canada 2021 census (Statistics Canada, 2023), which was retrieved through the cancensus R package (von Bergmann et al., 2021), in addition to the latest commute mode share data retrieved from Statistics Canada (2024). The weights did range from 0.1 to 5 and were incorporated in all statistical analysis.

We examined the associations of main commute mode and travel time with each dependent variable, controlling for sociodemographic characteristics, travel mode attitudes, and region dummy variables. The sociodemographic variables included age, income, gender, and number of teleworking days per week. Disability and household size were discarded due to lack of statistical significance in the initial models. Travel mode attitudes are captured with binary indicators for factors respondents selected as important when deciding to use their main mode which can be framed as both attitudinal preferences ("My physical and/or mental health", "It is better for the environment than other modes", "I am more comfortable using this mode to travel than when using other modes," "I am able to be productive on my journey", "I have a shorter travel time than with other modes") and practical constraints ("It is cheaper for me than other modes," and "Other modes don't go where I need to go"). Finally, while separate models are estimated for regions of similar size, we include a region variable to account for potential inter-regional differences.

5. Results

5.1. Descriptive statistics

About half or more of the respondents found that their commute mode positively impacts their energy and productivity at work and punctuality in getting to work (Table 1 – Subsample descriptive statistics). The car was used for commuting by over half of the respondents in mid-size and small regions (60.1% and 62.8%, respectively) while less than half of the respondents in large regions commuted by car (42.3%). Active modes were more popular than transit in all subsamples. Large regions had the highest share of active commuters with 17.0% cycling and 10.5% walking to work, in addition to the highest share of transit use with 19.3% of respondents commuting via subway and 10.9% via bus or streetcar.

Average commute duration was shortest for respondents in small regions (26.0 min) compared to mid-size regions (30.5 min), and large regions (35.2 min). The most commonly stated reason for mode choice was a shorter travel time, with more than two-thirds of respondents in regions of all sizes agreeing. Comfort was commonly selected by respondents in small (43.2%), mid-sized (43.9%), and large regions (40.0%) as a rationale behind the mode selection. Many respondents were motivated in their mode choice by their physical/mental health (40.7% in large regions, 37.8% in mid-size regions, and 39.4% in small regions). Cost (40.6%) and environmental reasons (30.2%) were common reasons for mode choice and were more frequently cited in large regions than in mid-size and smaller regions.

For energy and productivity at work across all region sizes, more respondents rated cycling and walking as positive followed by car users then transit users (Fig. 3). For punctuality in getting to work, more bicycle users rated a positive impact than car users in large regions, however, in mid-size and small regions, ratings of car users were either on par with or greater than active mode users. Transit users were distantly behind active and car commuters for perceptions of punctuality in all three subsamples.

5.2. Statistical model results

This section presents the results of the weighted logistic regression models with the three work performance measures as outcome variables: energy at work (Table 2), productivity at work (Table 3), and punctuality in getting to work (Table 4). Of the three work performance measures, the models for energy at work explain most of the variation with R^2 values ranging from 0.211 to 0.215. Punctuality in getting to

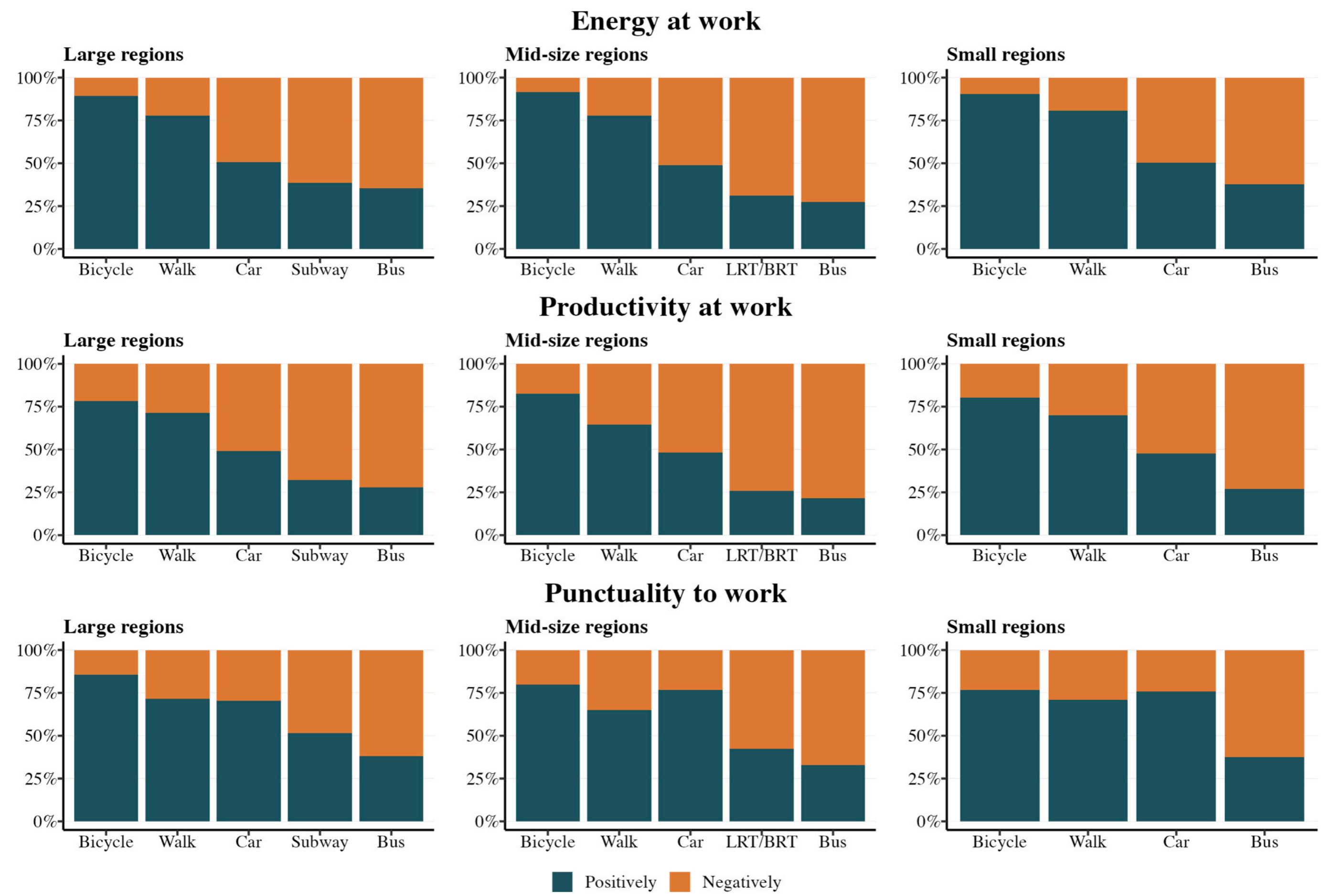

Fig. 3. Respondents' self-assessment for the impact of commute mode on energy, productivity, and punctuality by region size.

work models show similar explanatory power (R^2 between 0.188 and 0.202), while self-assessed productivity's model fits slightly lower (R^2 between 0.178 and 0.186).

Active mode use, especially cycling, was associated with higher odds of greater self-assessed energy and productivity at work. Workers who cycle to work had 5.60 times higher odds of reporting more energy at work in mid-size regions, 3.47 times higher in large regions, and 3.28 times higher in small regions, compared to car users, all else equal. The strong positive association of cycling with self-assessed productivity was most pronounced in mid-size regions (OR = 3.25) followed by small and large regions (OR = 2.19 and 2.18, respectively), ceteris paribus. In small regions, walking was associated with 2.43 greater odds of energy at work compared to car users while keeping all other variables at their mean. Walking to work in mid-size regions was associated with 2.12 greater odds of energy at work and 1.70 greater odds of productivity. Unlike energy and productivity at work, walking was associated with significantly lower odds for punctuality than car commuting in all region sizes. The odds for punctuality were reduced the most in large regions (OR = 0.34) followed by mid-size regions (OR = 0.40) and small regions (OR = 0.52). Cycling was not statistically associated with punctuality.

Compared to drivers, transit users tended to have lower odds of self-assessed energy, productivity, and punctuality across the board, though the magnitude of the association varied by region type and transit mode. Subway use was associated with reduced odds of energy at work by 34% and productivity by 48% relative to car use. LRT/BRT use was not associated with energy or productivity but was associated with reduced odds of punctuality by 65%, ceteris paribus. Bus users generally fared the worst compared with other transit modes, and the outcomes tended to be worse in smaller regions. Bus use was associated with lower odds of energy at work by 40% in large regions and 55% in small regions relative to commuting by car, all else equal. Similarly, odds of productivity at work for bus users were 51% lower in large regions, 58% lower in mid-size regions, and 70% lower in small regions. Self-assessed punctuality for bus users was 47% lower than car commuters in large regions, 77% in mid-size regions, and 68% in small regions.

Commute duration was negatively associated with outcomes across all models. An additional five minutes of commute times reduced the odds of energy at work by 11 to 13%, with the association being slightly stronger in small regions, all else equal. Similarly, there was an 11% reduction in odds of productivity at work in large and mid-size regions and 12% in small regions for every 5 additional minutes of commute time. Commute duration was strongly associated with lower odds of punctuality (18% to 19% reduced odds across the three region sizes).

There was a small association with age in the models for productivity in all three region sizes and women were more likely to report a positive influence of their commute mode on their productivity in large and mid-size regions. The influence of working from home was statistically significant and negative in large regions on self-assessed productivity at work, with each additional day per week spent working from home lowering the odds of post-commute productivity at work by 9% ceteris paribus.

Certain attitudes and preferences regarding chosen mode played a role in determining self-assessed impacts of commute mode on work performance. In all nine models, preference for comfort consistently emerged as a predictor of positive work performance outcomes. Choosing a commute mode for physical/mental health reasons was associated with higher odds of perceiving a positive impact on energy at work and productivity at work across all region sizes. Environmental

Table 2
Energy at work weighted logistic regression models.

Energy at work	**Large regions (N = 2,109)**		**Mid-size regions (N = 1,923)**		**Small regions (N = 2,639)**	
Predictors	*OR*	*CI (95%)*	*OR*	*CI (95%)*	*OR*	*CI (95%)*
(Intercept)	1.04	(0.64–1.68)	0.69	(0.41–1.17)	0.67	(0.42–1.08)
Age	1.00	(1.00–1.01)	1.00	(1.00–1.01)	1.00	(1.00–1.01)
Gender (Women)	1.14	(0.95–1.38)	1.25 *	(1.03–1.53)	0.95	(0.81–1.12)
Income (ref. Above $120 k)						
$60 k to $120 k	1.05	(0.84–1.31)	1.12	(0.90–1.40)	1.26 *	(1.04–1.52)
Less than $60 k	1.28	(1.00–1.65)	0.94	(0.71–1.25)	1.12	(0.90–1.39)
Days teleworking	0.97	(0.90–1.04)	0.98	(0.91–1.06)	1.02	(0.96–1.08)
Main mode (ref. Car)						
Bicycle	3.47 ***	(2.00–6.27)	5.60 ***	(3.01–11.10)	3.28 ***	(1.89–5.94)
Walk	1.15	(0.72–1.87)	2.12 **	(1.23–3.77)	2.43 ***	(1.52–3.98)
Bus or streetcar	0.60 *	(0.38–0.96)	0.65	(0.39–1.08)	0.45 ***	(0.30–0.69)
Subway	0.66 *	(0.46–0.94)				
LRT or BRT			0.81	(0.46–1.42)		
Commute duration (5 mins)	0.89 ***	(0.86–0.91)	0.88 ***	(0.84–0.91)	0.87 ***	(0.84–0.90)
Reasons for mode choice						
Physical/mental health	1.88 ***	(1.50–2.35)	1.87 ***	(1.49–2.36)	1.75 ***	(1.45–2.12)
Better for environment	1.92 ***	(1.32–2.80)	1.43	(0.96–2.14)	2.73 ***	(1.89–3.98)
More comfortable	1.63 ***	(1.33–1.99)	1.63 ***	(1.33–2.01)	1.81 ***	(1.52–2.16)
Able to be productive	1.01	(0.73–1.39)	2.33 ***	(1.64–3.34)	1.16	(0.88–1.52)
Cheaper	0.76 *	(0.58–0.99)	0.90	(0.68–1.20)	0.96	(0.73–1.25)
Shorter travel time	1.20	(0.96–1.49)	1.27 *	(1.00–1.61)	1.06	(0.87–1.29)
Other modes don't go where I need to go	0.67 ***	(0.53–0.85)	0.68 **	(0.53–0.87)	1.27 *	(1.04–1.56)
Region						
Toronto (ref.)						
Montréal	1.38 **	(1.09–1.75)				
Vancouver	1.22	(0.97–1.53)				
Edmonton (ref.)						
Calgary			1.02	(0.79–1.32)		
Ottawa			1.18	(0.93–1.50)		
Hamilton (ref.)						
Victoria					1.08	(0.78–1.49)
Halifax					1.23	(0.91–1.66)
Québec					2.29 ***	(1.70–3.10)
Winnipeg					1.16	(0.86–1.56)
Saskatoon					1.21	(0.88–1.68)
R^2 Tjur	0.215		0.218		0.211	

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

consciousness also played a role in positive outcomes, but the influence varied more by region and performance domain. The ability to be productive during the commute increased the odds of productivity at work in all region sizes, especially in mid-size regions. Conversely, cost sensitivity lowered odds of positive work performance in some contexts. Valuing low cost reduced odds in large regions by 24% for energy at work and by 38% for punctuality in small regions.

Region dummies were included in all models; only Montréal (in large regions) and Québec City (in small regions) were statistically significant and positive in the energy and productivity models. This indicates that workers in Montréal were more likely than those in Toronto, and workers in Québec City more likely than those in Hamilton, to report a positive impact of their commute on their energy and productivity at work.

5.3. *Sensitivity analysis*

Since commute time was one of the important variables in the above models, we conducted a sensitivity analysis using the outputs of the weighted logistic regression models to examine how commute duration influenced the three work performance measures (energy, productivity, and punctuality) for each commute mode across various durations (Fig. 4). These probabilities were calculated for the reference regions in each model (Toronto for large regions, Edmonton for mid-size regions, and Hamilton for small regions), using a standard profile: a 40-year-old man with household income above $120 k who did not report reasons for choosing his commute mode.

Across all modes, region sizes, and performance indicators, the probability of positive work performance declined with longer commute times, though at varying rates. Cyclists consistently reported the highest probability of positive impacts on energy at work across regions and commute durations. Although this probability decreased with longer commutes, even at 45 min it remained similar to or higher than the maximum probability observed for drivers and transit users at a 5-minute commute time.

Transit users, especially bus riders, had the lowest probability of positive outcomes for energy and productivity at work across all region sizes. At 45 min of travel time, bus users in small regions had negligible probabilities (0–5%) compared to 10–20% in large and mid-size regions. Out of the three performance measures, punctuality declined the most as commutes got longer, with probabilities almost cut in half around 50 min. For example, cyclists in large regions had around 80% probability of punctuality at a 5-minute commute, which fell to nearly 40% at 50 min of commute duration.

6. Discussion

The higher likelihood of reporting positive impact of commute on energy and productivity among active commuters, particularly cyclists, aligns with previous literature on active travel and work performance (Loong et al., 2017; Ma & Ye, 2019; Page & Nilsson, 2017). The positive effects of cycling to work on work performance were consistent across all region types. This can be due to the well-established positive impacts of cycling on mental and physical health (Garrard et al., 2021; Mueller et al., 2015), especially right after the commute (Brutus et al., 2017; Kalliolahti et al., 2024). It is worth noting that the positive associations with cycling to work were more pronounced in mid-size regions compared to others. One possible explanation is that commuting by

Table 3
Productivity at work weighted logistic regression models.

Productivity at work	Large regions (N = 2,109)		Mid-size regions (N = 1,923)		Small regions (N = 2,639)	
Predictors	*OR*	*CI (95%)*	*OR*	*CI (95%)*	*OR*	*CI (95%)*
(Intercept)	0.91	(0.57–1.48)	0.51 *	(0.30–0.87)	0.50 **	(0.31–0.80)
Age	1.01 *	(1.00–1.02)	1.01 ***	(1.01–1.02)	1.01 ***	(1.01–1.02)
Gender (Women)	1.31 **	(1.09–1.59)	1.23 *	(1.01–1.50)	0.92	(0.78–1.08)
Income (ref. Above $120 k)						
$60 k to $120 k	1.10	(0.89–1.37)	1.05	(0.84–1.30)	1.22 *	(1.02–1.48)
Less than $60 k	1.11	(0.87–1.42)	0.77	(0.58–1.02)	1.00	(0.81–1.24)
Days teleworking	0.91 **	(0.85–0.98)	0.95	(0.88–1.03)	0.99	(0.93–1.05)
Main mode (ref. Car)						
Bicycle	2.18 **	(1.35–3.58)	3.25 ***	(1.88–5.78)	2.19 **	(1.34–3.65)
Walk	1.07	(0.67–1.70)	1.70 *	(1.01–2.89)	1.11	(0.72–1.70)
Bus or streetcar	0.49 **	(0.30–0.79)	0.42 **	(0.24–0.71)	0.30 ***	(0.19–0.47)
Subway	0.52 ***	(0.36–0.76)				
LRT or BRT			0.61	(0.34–1.08)		
Commute duration (5 mins)	0.89 ***	(0.86–0.91)	0.89 ***	(0.86–0.93)	0.88 ***	(0.85–0.91)
Reasons for mode choice						
Physical/mental health	1.71 ***	(1.37–2.14)	1.43 **	(1.13–1.79)	1.58 ***	(1.31–1.91)
Better for environment	1.42	(0.99–2.06)	1.50 *	(1.02–2.23)	2.54 ***	(1.79–3.62)
More comfortable	1.46 ***	(1.19–1.78)	1.55 ***	(1.26–1.90)	1.56 ***	(1.31–1.85)
Able to be productive	1.66 **	(1.20–2.30)	2.28 ***	(1.62–3.24)	1.34 *	(1.02–1.75)
Cheaper	0.77	(0.60–1.01)	0.94	(0.71–1.25)	1.02	(0.79–1.33)
Shorter travel time	1.22	(0.98–1.51)	1.23	(0.97–1.55)	0.97	(0.80–1.18)
Other modes don't go where I need to go	0.71 **	(0.56–0.90)	0.68 **	(0.53–0.87)	1.27 *	(1.05–1.55)
Region						
Toronto (ref.)						
Montréal	1.30 *	(1.02–1.64)				
Vancouver	0.94	(0.75–1.18)				
Edmonton (ref.)						
Calgary			1.07	(0.83–1.38)		
Ottawa			1.15	(0.91–1.46)		
Hamilton (ref.)						
Victoria					1.03	(0.75–1.42)
Halifax					1.31	(0.97–1.77)
Québec					2.12 ***	(1.58–2.86)
Winnipeg					1.32	(0.99–1.77)
Saskatoon					1.22	(0.88–1.69)
R^2 Tjur	0.186		0.182		0.178	

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

bicycle in mid-size regions may attract a more self-selective group of highly enthusiastic cyclists, while a greater prevalence of cycling infrastructure in large regions may encourage a broader spectrum of utilitarian users. The distinction between enthusiastic cyclists and cyclists motivated by convenience has been noted in previous research (Willis et al., 2013) and may be relevant to the commute spillover effect, though the observed pattern here warrants further investigation. A second hypothesis can be related to the reduced stress from traffic in these mid-size regions compared to larger ones. This finding can be used to encourage employers to adopt cycling friendly strategies at workplaces, such as providing secured bicycle parking areas, changing rooms, and showers (Buehler, 2012), as, if causal, those strategies would support cycling and, in turn, higher productivity at work.

Transit users reported the most negative outcomes in all regions. Buses and streetcars often operate in mixed-traffic conditions, which may make them more vulnerable to congestion and delays, potentially having negative implications on workers' energy and punctuality. Additionally, crowdedness in popular routes can cause stress and exhaustion (Gimenez-Nadal & Molina, 2019; Legrain et al., 2015), which may influence productivity at work (Loo & Tsoi, 2024). In mid-size and large regions where LRT/BRT and subway exist, these modes still underperformed compared to the car for all three outcomes. These results could also be attributed to crowding and delays along these modes. Transit infrastructure investments should consider not just capacity or coverage but speed, comfort, and opportunities to use travel time productively as these factors were associated with better self-assessed work performance. The findings regarding the length of the commute aligns with previous findings of longer commutes being both more stressful and fatiguing (Gimenez-Nadal & Molina, 2019; Legrain et al., 2015) and associated with higher absenteeism (Ma & Ye, 2019). Accordingly, planning for better accessibility via public transit with land use and/or transport planning interventions will lead to a reduction in travel times and can be an effective way to reduce the negative spillover effect of the post commute (Deboosere & El-Geneidy, 2018; Levinson, 1998).

The more frequently people work from home in large regions the less likely they are to report positive outcomes from their commute on productivity. This finding may signify that frequent telecommuters find it harder to adapt with the commute days when they travel to a workplace as they feel less productive at work compared to frequent commuters. We find alignment here with previous findings where those who commute more frequently are more positive about their commute (Ettema et al., 2012). This finding raises some questions that require further investigation on the effectiveness of hybrid working models when it comes to self-assessed productivity, especially in larger regions.

As travel-related attitudes have been shown to both directly and indirectly affect commute satisfaction (Ye & Titheridge, 2017), accounting for underlying mode preferences shaped by values and beliefs is crucial to avoid overestimating the associations between travel mode and workplace outcomes. Placing importance on environmental consciousness and physical/mental health were associated with higher odds of perceiving a positive impact of commute mode on workplace outcomes. This may reflect greater subjective well-being stemming from value alignment, which has been linked to higher productivity (Diener, 2012). Valuing comfort and perceived productivity during the commute were also associated with positive outcomes at work, similar to previous studies (Smith, 2017; St-Louis et al., 2014). The relationships observed in this study support the idea that subjective attitudes towards mode

Table 4
Punctuality in getting to work weighted logistic regression model.

Punctuality to work	Large regions (N = 2,109)		Mid-size regions (N = 1,923)		Small regions (N = 2,639)	
Predictors	*OR*	*CI (95%)*	*OR*	*CI (95%)*	*OR*	*CI (95%)*
(Intercept)	2.99 ***	(1.75–5.13)	4.04 ***	(2.23–7.34)	3.89 ***	(2.30–6.59)
Age	1.01 ***	(1.01–1.02)	1.01	(1.00–1.02)	1.00	(1.00–1.01)
Gender (Women)	1.20	(0.97–1.48)	1.18	(0.94–1.48)	0.93	(0.77–1.12)
Income (ref. Above $120 k)						
$60 k to $120 k	1.00	(0.79–1.27)	0.94	(0.73–1.21)	1.10	(0.89–1.36)
Less than $60 k	1.72 ***	(1.28–2.32)	0.98	(0.71–1.35)	0.89	(0.69–1.13)
Days teleworking	0.96	(0.89–1.04)	1.01	(0.92–1.10)	0.96	(0.90–1.03)
Main mode (ref. Car)						
Bicycle	1.29	(0.75–2.26)	0.66	(0.38–1.16)	0.72	(0.44–1.20)
Walk	0.34 ***	(0.21–0.56)	0.40 **	(0.23–0.70)	0.52 **	(0.34–0.83)
Bus or streetcar	0.53 **	(0.33–0.86)	0.23 ***	(0.14–0.38)	0.32 ***	(0.21–0.48)
Subway	0.89	(0.62–1.29)				
LRT or BRT			0.35 ***	(0.20–0.60)		
Commute duration (5 mins)	0.81 ***	(0.78–0.83)	0.82 ***	(0.79–0.86)	0.81 ***	(0.78–0.84)
Reasons for mode choice						
Physical/mental health	1.21	(0.94–1.57)	0.88	(0.67–1.15)	1.25	(1.00–1.56)
Better for environment	1.27	(0.87–1.88)	1.48	(0.99–2.23)	1.92 ***	(1.33–2.79)
More comfortable	1.73 ***	(1.37–2.17)	1.67 ***	(1.32–2.13)	1.58 ***	(1.29–1.93)
Able to be productive	1.01	(0.71–1.45)	1.20	(0.82–1.80)	1.25	(0.91–1.74)
Cheaper	0.90	(0.68–1.20)	1.21	(0.88–1.68)	0.62 ***	(0.47–0.83)
Shorter travel time	1.74 ***	(1.38–2.20)	1.85 ***	(1.44–2.37)	1.65 ***	(1.34–2.03)
Other modes don't go where I need to go	0.81	(0.63–1.05)	0.94	(0.71–1.25)	1.00	(0.79–1.25)
Regions						
Toronto (ref.)						
Montréal	1.16	(0.89–1.52)				
Vancouver	0.92	(0.72–1.18)				
Edmonton (ref.)						
Calgary			0.95	(0.71–1.28)		
Ottawa			0.89	(0.68–1.17)		
Hamilton (ref.)						
Victoria					1.05	(0.74–1.49)
Halifax					0.93	(0.67–1.28)
Québec					1.46 *	(1.05–2.03)
Winnipeg					1.35	(0.97–1.87)
Saskatoon					1.25	(0.86–1.81)
R^2 Tjur	0.202		0.206		0.188	

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

used not only mediate the relationship between mode choice and commute satisfaction (St-Louis et al., 2014; Ye & Titheridge, 2017), but are relevant to the commute spillover effect. Educational awareness campaigns at workplaces on the impacts of commute on work performance might be one way to increase the positive spillover effect of the commute and create mindfulness regarding mode selection.

7. Conclusion

This study examined the self-assessed impact of commute mode on three aspects of post-commute work performance, namely energy and productivity at work and punctuality in getting to work using a large sample of Canadian commuters in large, mid-size, and small metropolitan regions. The findings confirm that commuting is not a neutral activity; it can shape how workers feel and perform at work, validating the hypothesized relations suggested by Lim et al. (2024). Travel modes, travel duration, sociodemographic characteristics, and preferences and constraints around mode choice shape how individuals perceive the impact of their commute on work performance. Active commuters, especially cyclists, reported the highest positive impacts of their commute mode on energy and productivity at work across all region types, followed by car drivers then transit users. Longer commute times consistently undermined all three work performance self-assessed outcomes.

While this study provides insight into the self-assessed impacts of commuting by a variety of modes, there are many additional factors that can shape the commute experience and spillovers into the workplace that were unaccounted for. Detailed itinerary of travel, rather than relying on the main mode of travel, could provide deeper insights into the variation in the work outcomes, especially among public transit users. While the generated models used weights to correct for biases in the sampling, a larger sample across each region could help in reducing biases related to receiving more responses from active transport users. The finding from the number of work-from-home days is interesting and invites further investigations in this area, especially in larger regions.

Future surveys might include detailed questions regarding the direct impacts of working from home on self-assessed work outcomes. Several work-related and lifestyle factors that were not accounted for in this study may influence the relationships between commuting and work performance. Contextual factors such as job satisfaction or work-family life interference can shape commuting experiences, and, in turn, affect performance at work, creating a feedback loop (Lim et al., 2024). This study did not directly examine the potentially moderating role of in-commute activities including the increasingly common use of information and communication technologies (Lim et al., 2024). Investigating whether engaging in productive tasks during the commute can facilitate the transition between home and work or exacerbate work-life balance may provide useful insights into post-commute effects on work performance. Future research might take advantage of a mixed methods approach, where interviews and open-ended questions are analyzed to add more nuance to survey approaches.

CRediT authorship contribution statement

Andie Heck: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Formal analysis, Conceptualization. **Hisham Negm:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Resources, Project

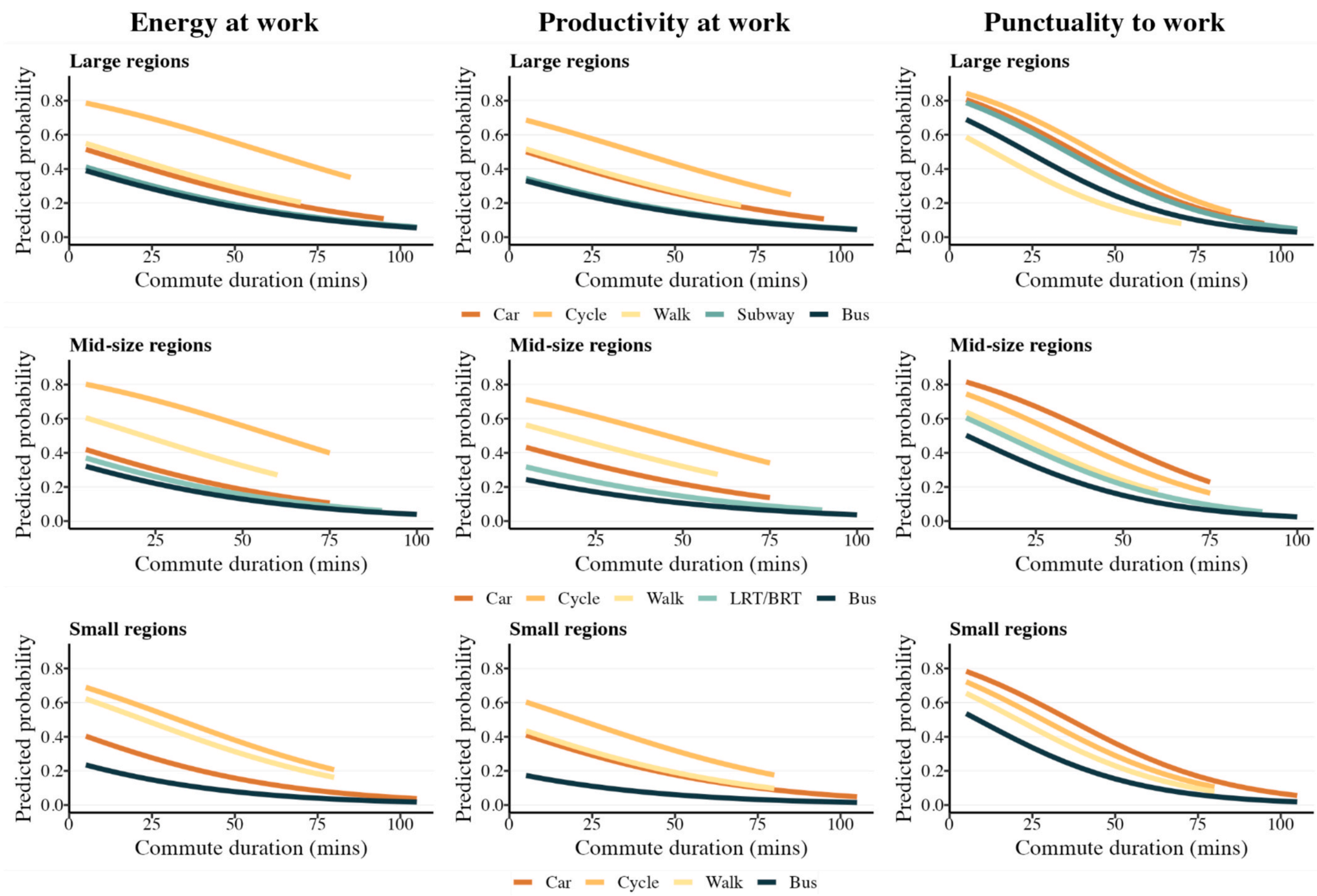

Fig. 4. Sensitivity curves by commute mode and commute duration for energy, productivity, and punctuality.

administration, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Nancy A. Ross:** Writing – review & editing, Validation, Supervision, Methodology, Funding acquisition, Conceptualization. **Ahmed El-Geneidy:** Writing – review & editing, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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