Université de Montréal

TOWARD MORE SUSTAINABLE BEHAVIOR: AN INVESTIGATION INTO THE MOBILITY RESPONSES TO AN INVOLUNTARY WORKPLACE RELOCATION OF 10,000 EMPLOYEES IN MONTREAL, CANADA

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Abstract

Despite traffic congestion, air pollution, greenhouse gas emissions, as well as the connection to road crashes and physical inactivity, the car remains the prevalent mode of transport in North America. This over-reliance on cars relative to public and active transport modes is even more evident during peak hours. However, evidence suggests that the habit of car use is likely to be disrupted in important life-changing situations such as the birth of a child, or the relocation of a workplace. In such circumstances, attentiveness to alternative solutions and transport modes will increase, hence, a higher probability of a conscious (re)consideration of current travel behavior and a change is expected. From a policy planning perspective, these moments are highly valuable as they open up a "window of opportunity" for introducing and encouraging the use of sustainable transportation alternatives and for promoting health and environmental concerns.

Whether it is voluntary or involuntary, uprooting and moving an activity to another location is a complex event from a socio-psychological perspective. It exposes people to a novel situation regarding geographical accessibility to home, work, amenities, transport services, parking, bike lanes, as well as other contextual characteristics including diversity of population and security, all of which can trigger the need for mobility rearrangement. Furthermore, relocation can stimulate travel behaviour change by influencing individual's attitudes, values, and habits. In fact, modal choice is a very complex decision process determined by a wide range of spatial, economic, social, and psychological factors. In this context, a deeper understanding of individual's daily travel behaviour and modal choices is necessary in order to take adequate policy measures to guide mobility towards more sustainable behaviors.

In this context, this dissertation targets the travel behaviour of more than 10,000 employees of the McGill University Health Center (MUHC), Montreal, who experienced a significant life-changing event when five different work locations within the downtown core were merged into one peri-central location, the Glen Site, in 2015. One of the largest employment relocations in North American history, the super-hospital situated near the Vendome intermodal station is a strategic opportunity to advance basic knowledge on sustainable travel demand management. The underlying principle is to derive benefit from the disruption of habits and identifying the barriers of using low-carbon transport modes and to offer green transport opportunities in situations where there is increased attentiveness to alternative modes. Accordingly, this dissertation will answer the following research question: *In an attempt to guide mobility towards a more sustainable future, how do the travel-related impacts of involuntary workplace relocation help improve our understanding of the choice of household's daily mobility in metropolitan territory?* To answer this question, the following objectives will be pursued through the production of three journal papers built on one another:

1. To develop a comprehensive presentation of modal choice determinants, and in particular **factors affecting commuting** behaviour during the process of workplace relocation as well as effective measures that **incentivize sustainable commuting**.
2. To examine the extent to which **commute mode choice and satisfaction** are interdependent by looking at socio-demographic characteristics, residential location and car ownership in the context of a major involuntary workplace relocation.

3. To expand our understanding of the **complex causalities** and **rationales** underlying travel-related choices and changes as well as their links to travel **attitudes, dissonance and satisfaction**.
4. To understand how individuals rank and prioritize their **travel-related attitudes and values** within the various **domains of life** in order to maximize their **life satisfaction** when experiencing a context change.

Using both quantitative (n=1977, ~26% response rate) and qualitative (n=19) methods, we collected and analyzed data on before- and after-the-move decisions made by the employees regarding: 1) their travel patterns, 2) barriers of using low-carbon transport modes, and 3) the underlying rationales for change (or not). Whereas research in this field is dominated by quantitative analyses, few studies have applied mixed method approaches where a qualitative approach provides a deeper insight into the complex causal relationships between subjective psychological concepts that quantitative methods are often unable to address thoroughly.

The overarching finding indicated that, while the existence of a regional train (in addition to metro and bus) at a major workplace has a positive impact on reducing private automobile use (15 percent increase in public transit use and 10 percent increase in travel satisfaction), the simple existence of alternatives is insufficient and further efforts are needed to encourage the use of low-carbon transport modes for daily commute. These efforts are most effective and functional if they are made at different stages during the process of the relocation, i.e., before, during, and after the relocation. The quantitative part also provided valuable insights into the importance of considering commuter's travel-related characteristics (including home location, car ownership, and other socio-economic status) when planning for major workplace relocations. Furthermore, results from our in-depth interviews shed light on the concept of weighted decision-making by discussing how individuals maximize their (travel and life) satisfaction by attributing different value and attitudinal weights to their choice alternatives. The perspective of weighted decision-making helped improve understanding of that satisfaction in various travel-related domains are interdependent and each can affect or be affected by overall life satisfaction. Among the respondents, the majority of the relatively low-income households (e.g., service jobs) lived in areas with low accessibility to adequate public transit, whereas many high-income employees (e.g., doctors and specialists) lived in affluent transit-oriented residential neighbourhoods allowing them to commute by low-carbon transport modes compared to the former group who felt forced to commute by car or endure frustrating commutes with multiple transfers between lines. Moreover, the construction of motorway interchanges and the corresponding heavy congestion around the Glen site has resulted in commute dissatisfaction for drivers, bus users, bicyclists and even pedestrian commuters. This dissertation calls for the contribution of key urban-transportation planners to tackle commute challenges in an attempt to increase subjective well-being, work satisfaction, and quality of life and guide mobility towards a more sustainable future.

Keywords: Travel behavior; Modal choice; Commute satisfaction; Workplace relocation; Montreal; Quantitative and qualitative methods; Weighted decision-making; Sustainability

Résumé

Les embouteillages, le prix élevé des carburants, la pollution atmosphérique et la contribution importante des voitures individuelles aux émissions de gaz à effet de serre, aux accidents de la route et à l'inactivité physique ne semblent pas troubler la grande majorité des propriétaires de voitures des sociétés occidentales, car la voiture reste le mode de transport le plus utilisé. Cette importante dépendance à l'égard de la voiture par rapport aux modes de transport publics et actifs est encore plus évidente aux heures de pointe, lorsque les trajets domicile-travail impliquent une lourde charge sur les réseaux routiers et aux infrastructures. Or, la recherche a montré que l'habitude de l'utilisation d'une voiture individuelle est susceptible d'être perturbée lors de situations significatives qui changent le cours de la vie, comme la naissance d'un enfant ou le déplacement d'un lieu de travail, type de situations qui est l'objet de cette thèse. Dans de telles circonstances, l'attention portée aux solutions et aux modes de transport alternatifs augmente, d'où une plus grande probabilité de (re)considérer les comportements de déplacement actuels et d'éventuellement les changer. Du point de vue de la planification des politiques, ces moments sont très précieux, car ils ouvrent une « fenêtre d'opportunité » pour introduire et encourager l'utilisation de solutions de transport durables et pour promouvoir les préoccupations en matière de santé et d'environnement.

Qu'ils soient volontaires ou involontaires, le déracinement et le déplacement d'une activité vers un autre lieu sont des événements complexes d'un point de vue socio-psychologique. Cela expose les gens à une situation nouvelle en ce qui concerne l'accessibilité géographique au domicile, au travail, aux équipements urbains, aux services de transport, au stationnement, aux pistes cyclables ainsi qu'à d'autres dimensions contextuelles, notamment la diversité de la population et la sécurité, ce qui peut alors déclencher le besoin de réaménager la mobilité. En outre, un déménagement peut stimuler le changement de comportement en matière de déplacement en influençant les attitudes, les valeurs et les habitudes des individus. En fait, le choix modal est un processus de décision très complexe déterminé par un large éventail de facteurs spatiaux, économiques, sociaux et psychologiques. Dans ce contexte, il est pertinent de mieux comprendre le comportement quotidien des individus en matière de déplacements et leurs choix modaux afin de prendre des mesures politiques adéquates pour orienter la mobilité vers des comportements plus durables.

Dans ce contexte, ce projet de recherche de doctorat s'intéresse aux comportements de déplacement de plus de 10 000 employés du Centre universitaire de santé McGill (CUSM), à Montréal, qui ont vécu en 2015 un événement important qui a changé leur vie lorsque quatre lieux de travail différents du centre-ville ont été fusionnés en un seul lieu péricentral au site Glen. Ce super-hôpital, situé près de la gare intermodale Vendôme, est l'une des plus importantes délocalisations d'emplois de l'histoire en Amérique du Nord. Il constitue une opportunité stratégique de faire progresser les connaissances fondamentales sur la gestion durable de la demande de transport. L'idée principale est de tirer profit de la rupture des habitudes et de l'identification des obstacles à l'utilisation de modes de transport à faible émission de carbone pour offrir des possibilités de transport écologique dans des situations où l'on est de plus en plus attentif aux modes alternatifs. En conséquence, l'objectif principal de cette thèse est de contribuer à la compréhension de la logique, de l'arbitrage et du choix de la mobilité des ménages sur le territoire métropolitain, en répondant à la question de recherche suivante : *dans le but d'orienter la mobilité vers une perspective plus durable, comment un déménagement (involontaire) du lieu de travail contribue-t-il à améliorer notre compréhension des (changements de) comportements de déplacement des individus ?* Pour répondre à cette question, les objectifs suivants sont visés grâce à la réalisation de trois articles scientifiques construits successivement :

1. Développer une présentation approfondie des déterminants du choix modal, et en particulier des facteurs affectant le comportement de déplacement pendant le processus de délocalisation du lieu de travail ainsi que des mesures efficaces qui incitent à des déplacements durables.
2. Examiner dans quelle mesure le choix du mode de transport et la satisfaction sont interdépendants en examinant les caractéristiques sociodémographiques, le lieu de résidence et la possession d'une voiture dans le contexte d'une relocalisation involontaire du lieu d'emploi.
3. Élargir notre compréhension de causalité complexes qui sous-tendent les choix et les changements liés aux déplacements, ainsi que leurs liens avec les attitudes, la dissonance et la satisfaction en matière de déplacements.
4. Comprendre comment les individus classent et hiérarchisent leurs attitudes et valeurs liées aux déplacements dans les divers domaines de la vie, afin de maximiser leur satisfaction dans la vie lorsqu'ils confrontés à un changement de contexte.

En utilisant des méthodes quantitatives (n=1977, taux de réponse d'environ 26 %) et qualitatives (n=19), nous avons recueilli et analysé des données sur les décisions prises par les employés avant et après la relocalisation : 1) leurs habitudes de déplacement, 2) les obstacles à l'utilisation de modes de transport à faible émission de carbone et 3) les raisons sous-jacentes de tout changement (ou non). Alors que la recherche dans ce domaine est dominée par les analyses quantitatives, peu d'études ont appliqué des approches de méthodes mixtes où une enquête qualitative permet de mieux comprendre les relations causales complexes entre des concepts psychologiques subjectifs que les méthodes quantitatives souvent incapables d'aborder de manière approfondie.

Le résultat principal montre que, si l'existence d'un train de banlieue (en plus du métro et du bus) vers le lieu de travail important a un impact positif sur la réduction de l'utilisation de l'automobile individuelle (augmentation de 15 % de l'utilisation des transports publics et de 10 % de la satisfaction des navettes quotidiennes), la simple existence d'une alternative à la voiture est insuffisante et des efforts supplémentaires sont nécessaires pour encourager l'utilisation de modes de transport à faible émission de carbone pour les trajets quotidiens. Ces efforts sont d'autant plus efficaces et effectifs lorsqu'ils sont déployés à différents stades du processus de relocalisation, c'est-à-dire avant, pendant et après la relocalisation. La perspective quantitative a également fourni des indications pertinentes sur l'importance de prendre en compte les caractéristiques des déplacements des navetteurs (notamment le lieu de résidence, la possession d'une voiture et d'autres statuts socio-économiques) lors de la planification de relocalisations à grande échelle de lieux d'emplois. En outre, les résultats de nos entretiens approfondis de la perspective qualitative ont mis en lumière le concept de prise de décision pondérée en examinant comment les individus maximisent leurs satisfactions (de mobilité et de la vie) en attribuant différentes valeurs et pondérations attitudinales à leurs choix. La perspective de la prise de décision pondérée a permis de mieux comprendre comment la satisfaction dans divers domaines liés aux navettes est interdépendante et que chacun des domaines peut affecter ou être affecté par la satisfaction globale de la vie. Parmi les répondants, la majorité des ménages à faible revenu relatif (par exemple, les emplois de services) vivaient dans des zones peu accessibles aux transports en commun, tandis que de nombreux employés à revenu élevé (par exemple, les médecins et les spécialistes) vivaient dans des quartiers résidentiels favorisés et orientés vers les transports en commun, ce qui leur permettait de se déplacer par des modes de transport à faible émission de carbone, alors que le premier groupe se considérait obligé de se déplacer en voiture ou d'endurer des déplacements frustrants avec des correspondances multiples. En outre, la construction d'échangeurs autoroutiers et la forte

congestion autour du site de Glen ont entraîné une insatisfaction des conducteurs, des utilisateurs de bus, des cyclistes et même des piétons. Cet enjeu a eu une influence négative sur la satisfaction au travail et la qualité de vie des employés. Ce projet de doctorat souligne ainsi le rôle clé des principaux planificateurs des transports urbains pour relever les défis liés aux déplacements afin d'accroître le bien-être subjectif et d'orienter la mobilité vers un avenir plus durable.

Mots-clés : Comportement de déplacement ; Choix modal ; Satisfaction des trajets domicile-travail ; Délocalisation du lieu de travail ; Montréal ; Méthodes quantitatives et qualitatives ; Prise de décision pondérée ; Durabilité.

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Publications Details and Author Contributions

This dissertation consists of three manuscripts that have been submitted to peer-reviewed journals. All manuscripts were completed with co-authors; details of author contribution are given below.

Chapter 3 "Toward more sustainable behaviour: A systematic review of the impacts of involuntary workplace relocation on travel mode choice" – by Zahra Zarabi and Sébastien Lord – is published in the *Journal of Planning Literature,* Volume 34(1): 38-58, 2019 and is included with permission from Sage. Professor Sébastien Lord contributed intellectually and provided comments and edits to the manuscript. Zahra Zarabi was the primary author of the manuscript. She performed all of the data analysis, interpretation of the results and writing.

Chapter 5 "Travel satisfaction vs. life satisfaction: A weighted decision-making approach" – by Zahra Zarabi, Philippe Gerber, and Sébastien Lord – which is published in the *Journal of Sustainability,* Volume X(X): p-p, 2019 and is included with permission from MDPI. Philippe Gerber and Sébastien Lord contributed intellectually and provided comments and edits to the manuscript. They also provided help with the data collection and quantitative data analysis. Zahra Zarabi was the primary author of the manuscript. She performed the quantitative and qualitative data analysis, interpretation of the results and writing.

Appendix IV "The impacts of residential relocation on commute habits: A qualitative perspective on households' mobility behaviours and strategies" – by Zahra Zarabi, Kevin Manaugh, and Sébastien Lord – is published in the *Journal of Travel Behaviour and Society,* Volume 16, 131-142, 2019 and is included with permission from Elsevier. Kevin Manaugh and Sébastien Lord contributed intellectually and provided comments and edits to the manuscript. Zahra Zarabi was the primary author of the manuscript. She performed the data collection and analysis, interpretation of the results and writing. This paper was produced as part of a pilot study which was conducted before the execution of the full-scale MUHC research project with the aim of evaluating the feasibility, duration, and issues that might have taken place in the main study.

1. Chapter One: Introduction

1.1. Introduction

1.1.1. Background and research problems

The patterns of urban life and its interconnectedness to mobility and transport have fascinated scholars ever since the urban life began (Lilley, 2002; Mumford, 1961; Pahl, 1970). From emergence of industrialization onwards, urban life and transportation encountered a strong and persistent transformation and growth, inspiring works by Creighton (1970): Urban Transportation Planning and Bruton (1970): Introduction to Transportation Planning, for example. The rapid change in the scale of the cities, exacerbated urban problems including mobility of goods and individuals, all of which necessitated the provision and management of urban infrastructure more professionally (Schönfelder & Axhausen, 2010). In response to these concerns, transport planning and traffic engineering were two disciplines which emerged in the 1930s. Their main concentration was on providing individuals with a reasonably priced transportation for performing their spatially distributed activities.

Gradually in the later decades, with the help of large-sale computer-based models, the focus of transport planning was narrowed to the peak hours, when home-work journeys created critical issues in transportation (Levinson & Krizek, 2008; Schönfelder & Axhausen, 2010). Starting from the second half of the twentieth century, many industrialized and developed countries such as Canada and United States encountered persistent growth in home-work journeys (commuting trips), particularly with private automobiles. Despite the significant contribution of private transport to congestion and air and noise pollutions, the car remains the prevalent mode of transportation for the commute in most North American metropolitan areas (Schrank, Lomax, & Eisele, 2011). The primary explanation for this trend may be found in decreased costs and increased speed of car-based travels as well as suburbanization of population and employments in urban areas (van Ommeren, 2000).

Although work trips are not the majority of trips and distances traveled by people, they are of particular importance in transport planning due to the following reasons: Morning and afternoon rush hours derive the demand for capacity in road infrastructure and other transportation services,

which together make up the urban network (Levinson & Krizek, 2008). Additionally, commuting journeys play a frame-setting role for daily mobility by being much more regular and consistent than shopping and social trips (Manaugh, Miranda-Moreno, & El-Geneidy, 2010; Shearmur, 2006). Last but not the least, excessive dependence on cars for commuting trips, relative to public and active transport modes, carries significant social and environmental costs, including greenhouse gas emissions, construction and maintenance of dense road networks, provision of parking spaces, time loss in traffic congestion, negative externalities on health (e.g., physical inactivity and road accidents). (Sprumont, Viti, Caruso, & Konig, 2014).

In order to understand the reasons underlying transportation behaviors, a growing number of conceptual and empirical studies worldwide have been developed. Urban planners and transportation scholars have also widened the scope of their analysis from merely focusing on the built environment (e.g., transit services and road infrastructure) to the traveler's desires and need. Their research concentrated on the traveler as a decision maker individual whose travel behavior is formed through a complex process, determined by a wide range of spatial, economic, social, and psychological factors (De Witte, Hollevoet, Dobruszkes, Hubert, & Macharis, 2013). In this context, a more comprehensive evaluation of travel behavior and modal choices will help transport policies and planning practices in identifying more effective measures and strategies to synchronize the travelers' abilities, needs and preferences with transport policy priorities. On top of all priorities is to develop effective measures to incentivize sustainable commuting behaviors, that is, less automobile dependency and more public and active transport use.

1.1.2. Context of the research case study

The lack of well-connected multimodal public transportation systems in North America is one of the reasons for the insufficiency of empirical research on travel behavior (especially by transit) (Eluru, Chakour, & El-Geneidy, 2012). Montreal, Quebec, however, has a unique multimodal system which provides an appropriate setting to examine travel mode and route choice behavior. Montreal is the second most densely inhabited metropolitan area in Canada with a population of 4.3 million. According to the Statistics Canada 2016 Census results for journey to work (Statistics Canada, 2017), nearly 70 percent of trips are carried out by car, 22 percent by public transit, and 8 percent by active transport (walking and cycling). Although for a North American

city, Montreal has a relatively high share of transit ridership (Eluru et al., 2012), the high level of car use still leads the focus of public transportation strategists on encouraging the transit ridership.

Sustainable mobility is indeed one of the most important policy strategies developed over the last decades in major Canadian metropolitan areas (Paulhiac & Kaufmann, 2006). Although the proportion of Canadian public transit commuters has increased more compared to car commuters since 1996, driving to work remains the dominant commuting method for the vast majority of commuters in Canada (Statistics Canada, 2017). As explained earlier, Montreal is a good example of cities that face high car dependency and other related challenges (Eluru et al., 2012), namely how to manage growing urbanization while improving sustainable transport and individual's quality of life. One possible answer chosen by the agglomeration of Montreal is to retrofit some metropolitan areas in choosing and promoting the accessibility of existing public transit infrastructures thanks to possible large-scale urban planning projects (Douay & Roy-Baillargeon, 2015).

One of the noteworthy examples of these projects, and the case study of this dissertation, is the relocation of the McGill University Health Centre (MUHC) from five different locations in downtown Montreal to one peri-central area a few kilometers (~5km) from the old sites, called the Glen site, in 2015. With more than 10,000 employees, the MUHC concentrates access facilities through the presence of a suburban train station, a metro station (Vendôme), and various bus lines both integrated into the hospital complex, as well as the proximity of a motorway interchange serving two highways (A20/A15) structured at the national level. One of the largest employment relocations in North American history, this case study is a strategic opportunity to advance basic knowledge on sustainable travel demand management. The underlying principle is to derive benefit from identifying the logics, arbitrations, and choices of households' mobility (especially daily commute) in a situation where travel decisions are likely to be re-evaluated in response to the new commute journey experience. The following section will discuss the travel decision reconsiderations in more detail.

1.1.3. Mobility biographies approach

Luckily, research evidence has proved that the habit of car use is likely to be weakened or disrupted in important life-changing situations such as home relocation, the birth of a child, loss of a driver's

license, and more recently the COVID-19 pandemic and lockdown (Clark, Chatterjee, & Melia, 2016b; IEA, 2020; Kylili et al., 2020; O'Garra & Fouquet, 2020; Zarabi & Lord, 2019). This concept, known as "mobility biography", was first introduced by Lanzendorf (2003) and has garnered considerable attention in social-scientific research and practice worldwide during the past few decades. Upon the introduction of the term by Lanzendorf, a large number of other empirical research have been developed, mainly across some European countries, including Germany (Lanzendorf, 2010; Müggenburg, Busch-Geertsema, & Lanzendorf, 2015; Prillwitz, Harms, & Lanzendorf, 2006, 2007; Scheiner, 2007, 2014; Scheiner & Holz-Rau, 2013a, 2013b; Schoenduwe, Mueller, Peters, & Lanzendorf, 2015), Switzerland (Axhausen, Frei, & Ohnmacht, 2006; Beige & Axhausen, 2012), the Netherlands (De Groot, Mulder, Das, & Manting, 2011; Oakil, 2013; Sharmeen, Arentze, & Timmermans, 2014; van der Waerden, Timmermans, & Borgers, 2003), and the UK (Chatterjee, Sherwin, Jain, Christensen, & Marsh, 2012; Clark, Chatterjee, & Melia, 2016a; Clark, Chatterjee, et al., 2016b). Few studies have also emerged in Japan (Zhang, 2014; Zhang, Yu, & Chikaraishi, 2014), Asia (Abad, Schwanen, & Fillone, 2020), Australia (Bonham & Wilson, 2012) and the US (Klein & Smart, 2017; Mjahed, Frei, & Mahmassani, 2015; Rasouli, Timmermans, & van der Waerden, 2015).

Mobility biography suggests that context changes (Verplanken, Walker, Davisb, & Jurasek, 2008), turning points (Beige & Axhausen, 2012), life course/key events (Abad et al., 2020; Clark, Lyons, & Chatterjee, 2016; Klöckner & Matthies, 2004; Lanzendorf, 2010; Prillwitz et al., 2007; Scheiner, 2007), life trajectory (Oakil, 2013), or discontinuities (Verplanken & Roy, 2016; Verplanken et al., 2008) make changes to stable travel-related situations (possibilities, needs, abilities, and preferences) and cause existing habitual coping skills to become ineffective. As a result, attentiveness to alternative solutions and transport modes will increase. In this context, people are more likely to consciously consider their travel motives and values, evaluate the consequences of their actions and make more intentional travel-related decisions (Müggenburg et al., 2015; Stanbridge, Lyons, & Farthing, 2004; Verplanken et al., 2008). From a policy planning perspective, these moments are highly valuable as they open up a "window of opportunity" for introducing and encouraging the use of sustainable transportation alternatives and for promoting health and environmental concerns (Müggenburg et al., 2015; Verplanken & Roy, 2016; Verplanken et al., 2008).

Among the various life-changing events, relocation of residence or workplace are noteworthy examples that can both disrupt the habit of car use for daily home-work trips. Whether it is voluntary or involuntary, uprooting and moving to another location is a complex event from a social and psychological perspective (Hausman & Reed, 1991). It exposes people to a novel situation regarding geographical accessibility to home, work, amenities, transportation services, parking, bike lanes, as well as other contextual characteristics including diversity of population and security, all of which can trigger the need for mobility rearrangement (Behren, Puhe, & Chlond, 2018; Chatman, 2003; Pritchard & Frøyen, 2019; Vale & Pereira, 2016). Furthermore, relocation can stimulate commuting behavior change by influencing individual's attitudes, values, and habits (Clark, Chatterjee, et al., 2016b). Ignoring any of the objective or subjective determinants of modal choice can lead to over-estimation of other factors that can eventually force individuals to align themselves to the transport possibilities of the new location, which might be undesirable or non-preferred.

While the key event of residential relocation has garnered considerable attention in the literature of travel behaviour (e.g. Bohte, 2010; Reid Ewing & Robert Cervero, 2010; Handy, Cao, & Mokhtarian, 2005; Krizek, 2003; Schwanen & Mokhtarian, 2005), few studies have examined the significant contribution of workplace relocations to commute behaviour changes. A traveler who lives within walking distance of a metro station but works far away from public transit facilities (be they rail or bus) is highly likely to drive to work (Chatman, 2003; Vale & Pereira, 2016; Walker, Thomas, & Verplanken, 2015). It is suggested that employment centers with high accessibility to quality public transport stimulate a switch away from car commuting, and that mixed land uses at work locations encourage a mode shift to walking and cycling (Walker et al., 2015; Zarabi & Lord, 2019). In fact, commuting behavior is a function of both home and work location characteristics. Ignoring job location factors can lead to over/under-estimation of the impacts of the built environment characteristics of home location on commuting behaviour. Furthermore, it is not always feasible to intervene on residential environments to moderate travel behaviours, due to economic restrictions and the size and scale of the territory to be considered – as a result of the urban sprawl. Therefore, in order to contribute to the advancement of knowledge, it is essential to shift the standpoint from residential to workplace perspective and the commuting patterns and demands associated with it.

In this context, this Ph.D. research project targets the commuting behaviour of the MUHC employees who experienced a significant life-changing event when five workplaces in the downtown core were merged into one peri-central location. One of the enormous employment displacements in North American history, the super-hospital situated near the Vendôme intermodal station is a strategic opportunity to expand the existing research on sustainable travel demand management. The underlying principle, from the mobility biography standpoint, is to derive benefit from the disruption of habits and identifying the objective and subjective barriers of using low-carbon transport modes. In that sense, assessing travel behavior during disruptions is essential to the analysis of transportation network performance as trips are likely to be rescheduled or rerouted (Abad et al., 2020). The results can inform policy makers and planners who attempt to improve transportation infrastructures and offer green transport opportunities in situations where there is increased attentiveness to alternative modes.

1.1.4. Attitudes and values, satisfaction, and dissonance in daily commute

Attitudes and values

Recent transportation literature is substantially devoted to the relationship between behavior and key psychological constructs including attitudes and values, which affect preferences for various short-term and long-term travel-related actions (Clark, Chatterjee, et al., 2016b; Clark, Lyons, et al., 2016; De Vos, Schwanen, Van Acker, & Witlox, 2019; Van Acker, Mokhtarian, & Witlox, 2014; Verplanken & Holland, 2002). From choosing a residential location to a travel route or mode for daily (home-work) trips, travel-related decisions are influenced by the degree to which the performance of the behavior is positively or negatively valued. The extent to which a valuation leads to an action can be explained through attitude/value–behavior relationships. Values and attitudes are distinguished constructs—both of which can influence behavior. Values are motivational constructs that guide an individual to fulfill a highly abstract goal like security, hedonism, or universalism (Shalom H. Schwartz, 1992; Shalom H. Schwartz & Bilsky, 1990). For instance, protecting the environment and broad-mindedness are two values that fulfill the goal of universalism. Values can influence behavior in three ways: as cognitions that define a situation (e.g., as one in which environmentalism is involved), provoke goals (e.g., universalism), and guide action (e.g., signing a petition in favor of active modes infrastructure) (Verplanken & Holland,

2002). While values relate to abstract, meaning-producing cognitive structures, attitudes are viewed in terms of evaluations of specific and tangible entities (Rohan, 2000). Attitudes are the result of various elements including an individual's underlying value structure. According to Eagly and Chaiken (1993, p. 1): "Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor". The evaluation degree can vary from affective and cognitive evaluations (e.g., I like walking for commute, and walking can contribute to environmental preservation) to behavioral responses (e.g., walking for daily commute or participating in active transport encouraging campaigns) (Bohte, Maat, & van Wee, 2009). In fact, Eagly and Chaiken (1993) have used the word attitude to describe both tangible and abstract judgments that could be labeled as values. Therefore, in this dissertation (mainly Chapter 5), we use attitude(s)/value(s) when talking about the link between these constructs to commuting behavior.

Dissonance

Whether it is as favorable to be an attitude or as important to be a value, there are situations where people neither think about their values nor act upon their attitudes while making decisions. This discrepancy between one's action and one's attitudes/values towards that action, often referred to as a value–action gap or dissonance, is otherwise explained by earlier research (Blake, 1999; De Vos, 2018; Kollmuss & Agyeman, 2002; Schwanen & Mokhtarian, 2005). In travel behavior studies, dissonance can be viewed both in terms of residential dissonance and travel mode dissonance. While residential dissonance (i.e., residing in a neighborhood that does not match with one's travel attitudes and residential preferences) has garnered considerable attention in the relevant literature, possible dissonance between the choice of a commute mode and attitudes towards that mode has not yet been analyzed thoroughly. The presence of constraints in travel-related access (e.g., Cervero & Kockelman, 1997; Reid Ewing & Robert Cervero, 2010) and a lack of certain skills and competences are found to be significant (Stern, 2000). For instance, an individual with strong positive attitudes towards the environment but insufficient bike riding skill might be forced to use motorized modes for daily commute. Inaccessibility to efficient public transport in a suburban area is also a reason for choosing car over low-carbon transport modes. The presence of perceived behavioral control and perceived social norm (Ajzen, 1991) is also found to be a cause of incongruity between attitude/value and behavior.

Satisfaction

With the aim of increasing the quality of life of individuals and their subjective well-being (SWB), recent transportation researchers have started focusing on evaluating travel satisfaction. Travel satisfaction is an outcome of experienced feelings during travels and/or positive or negative evaluation of these travels (De Vos, 2019b). A traveller's feelings and evaluations often result from 1) the trip characteristics and the service offered (e.g., cost, duration, punctuality, etc.) and 2) the person's perception of and reaction to the service which varies based on his/her socio-psychological characteristics such as attitudes, values, habits, predispositions, etc. These factors are together called external and internal factors that influence travel satisfaction (St-Louis, Manaugh, van Lierop, & El-Geneidy, 2014). SWB, however, is an outcome of satisfaction in various life domains[1]; short-term affective reflections (e.g., satisfaction with a punctual bus during rush hours) and long-term overall satisfaction with life are mutually interdependent and can strengthen or weaken one another. Therefore, it is important to study commute satisfaction in a broader spectrum of life satisfaction.

1.2. Research question and objectives

The **overarching goal** of this dissertation is: *To expand the understanding of the choice of household's mobility in metropolitan territory*. This research goal will be achieved through answering the **research question** that is driving this dissertation:

> *In an attempt to guide mobility towards a more sustainable future, how do the travel-related impacts of involuntary workplace relocation help improve our understanding of the choice of household's daily mobility in metropolitan territory?*

To answer this research question, four research objectives have been identified, each corresponding to an analysis chapter in this dissertation. These objectives are as follows:

[1] Life domains are the specific, connected, and integrated areas in which people live and interact and which are customized to everyone's unique life. Examples of life domains include residence, neighborhood, health, education, work, family life, leisure and recreation, finance, and travel behavior) (Zhang, 2017).

1. To develop a comprehensive presentation of modal choice determinants, and in particular **factors affecting commuting** behaviour during the process of workplace relocation as well as effective measures that **incentivize sustainable commuting**.
2. To examine the extent to which **commute mode choice and satisfaction** are interdependent by looking at socio-demographic, residential mobility and car ownership characteristics in the context of a major involuntary workplace relocation.
3. To expand our understanding of the **complex causalities** and **rationales** underlying commute-related choices and changes as well as their links to travel **attitudes, dissonance and satisfaction**.
4. To understand how individuals rank and prioritize their **travel-related attitudes and values** within the various **domains of life** in order to maximize their **life satisfaction** when experiencing a context change.

To reach these objectives, this dissertation follows a manuscript-based approach, with three studies building on one another. Collectively, these manuscripts address both the planning and research realms of travel-related behaviour through a multifaceted approach.

The first objective acknowledges that it is essential to first acquire a comprehensive overview of the determinants of modal choice in general and commuting behavior in particular that have been presented in the academic literature. These determinants have been investigated mainly through literature that had similar research objectives as this thesis's i.e., mobility performances in the context of workplace relocation (objective 1). Secondly, the determinants found in the literature will be evaluated in the context of the project's case study (the MUHC, Montreal, Canada) which will then form the basis for examination of factors influencing commute satisfaction (Objective 2). While the second objective is pursued using quantitative survey, the third objective plays a complementary role through qualitative examination of the complex causalities and rationalisations that lie behind the choices and changes observed in the previous sections along with their links to attitudes, dissonance and satisfaction. Contrary to the majority of travel behavior research that focus on quantitative methods, this study will also employ qualitative method to achieve the third and fourth objectives. The fourth objective allows for expanding our understanding of how individuals attribute value to and prioritize choices when making decisions for adapting different travel-related domains of life in order to increase life satisfaction during a context change.

The research design consists of a combination of qualitative and quantitative methods (explained in more detail in Chapter 2) and is divided into three studies (Figure 1.1). Each study corresponds to a chapter of the dissertation, in addition to the introduction, research methodology, and conclusion chapters. Figure 1.1 presents the overall structure of the dissertation, including the research objective for each chapter, the sources of data used in each chapter, key methods applied and the level of analysis. As the figure indicates, the objectives/studies are building on one another and each one complements the other. While the first one (i.e., literature review) investigates the various determinants of modal choice to be examined by the thesis's case study quantitatively (objective 2, chapter 4), the quantitative examinations and analysis propose certain factors to be explored qualitatively in the next step (objective 3 and 4, chapter 5).

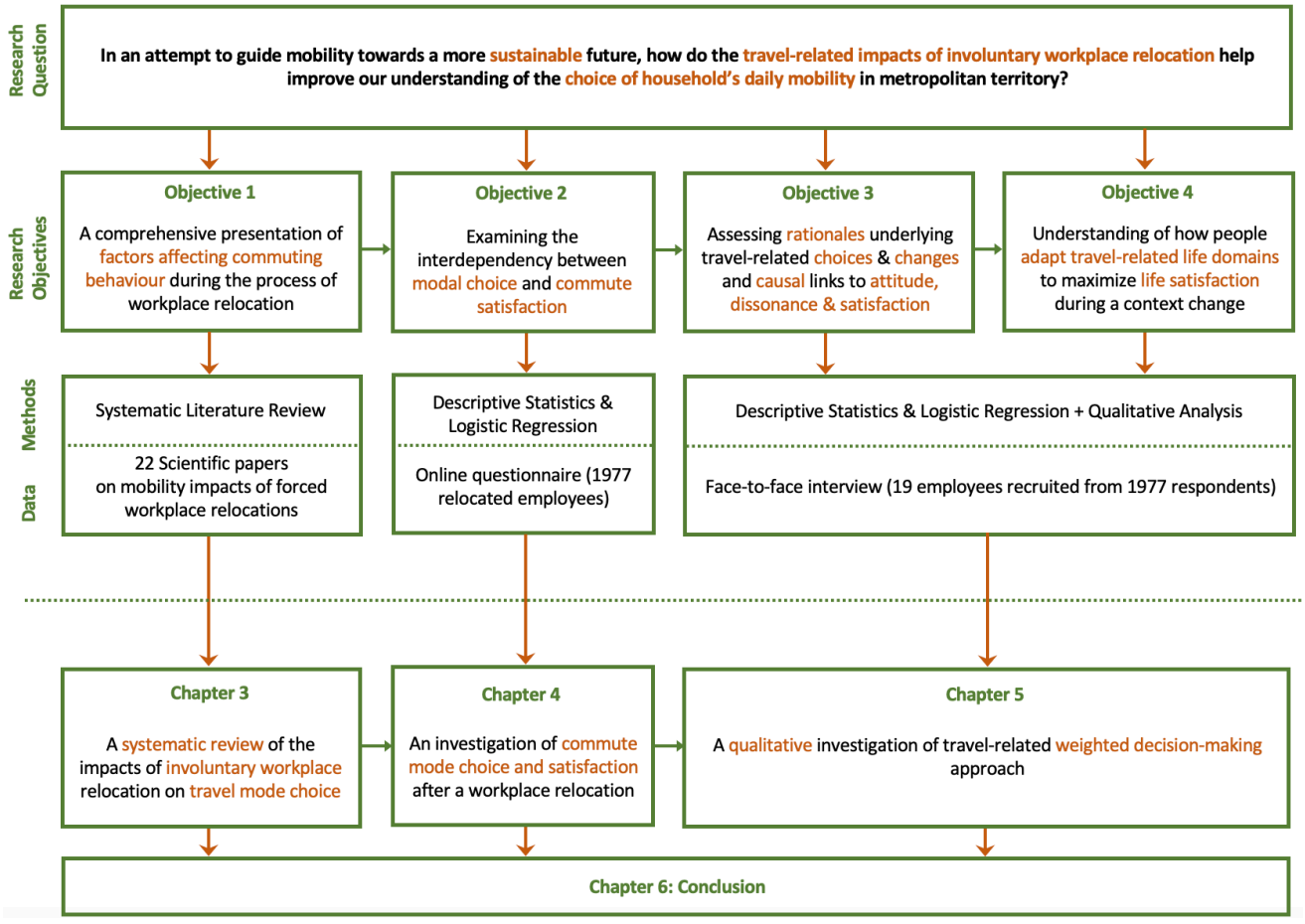


Figure 1.1 Research design and chapter objectives

1.3. Dissertation structure and overview of the chapters

This dissertation is structured in accordance with the guidelines of University of Montreal for a manuscript-based doctoral thesis. It is comprised of three manuscripts (and one manuscript in appendix) that collectively address the research question and objectives presented in the previous section. Chapters 3, 4, and 5 each correspond to a manuscript. They begin with a brief overview of the research, as well as distinct introduction, literature review, methodology, results/analysis and conclusion sections. Chapter 6 concludes the dissertation by consolidating the findings of the three manuscripts. This chapter also summarizes the contribution of the research in the context of broader research objectives and provides recommendations for the incorporation of low-carbon transport modes and sustainable mobility into the daily commute of individuals as well as avenues for future research. Appendixes have also been added to this thesis to provide the additional information that the reader might need to consult to fully understand the research project [2]. Below, a brief introduction of each chapter will commence.

Chapter 3 of this dissertation systematically reviews the literature on the impacts of involuntary workplace relocation on commuting behavior to identify motivations and barriers to incorporating the use of sustainable modes into the individual's daily commute. Effective measures that incentivize sustainable commuting behavior are also discussed. The study mainly reveals that during the process of forced workplace relocation, switching to car-based commute is – more than any socio-psychological factor – related to urban and transportation built-environment. Accordingly, factors such as home-work distance, access to road systems, (free) parking spaces, and inadequate public transit service were highlighted by most of the reviewed articles. This finding, however, is partly due to absence of data (quantitative and more importantly qualitative) and lack of investigation regarding the socio-psychological determinants of commute mode choice in the context of workplace relocation.

[2] As shown in the appendixes, a pilot study was conducted – a couple of months before the operation of the MUHC survey – on the mobility impacts of residential relocation of households who have had moved their residence during the last two years prior to the survey. This study not only helped us to examine the modal choice determinants and travel habit formation following a context change other than workplace but also enabled us to acquire an overview of the drawbacks and potential challenges that we might have faced with the MUHC survey.

The findings of the first study are strengthened by a second study in **Chapter 4** surveying 1,977 employees of the McGill University Health Center (MUHC), Montreal, Canada, who experienced an involuntary relocation of workplace in 2015. This study first examined the mobility responses and mode choice variations among the employees and their households by considering socio-demographic characteristics, certain travel and geographical characteristics, and commute satisfaction. Contrary to the dominant results from the systematic literature review which showed workplace displacements are often associated with switching to car-based commute, our study found that a workplace relocation can be followed by significant increase in public transit use if better accessibility to such modes is provided at the new work location. In our case study, the existence of a regional train (in addition to metro and many bus lines which existed at the former workplaces, too) played a central role in stimulating non-car-based commute. Furthermore, the presence of extensive constructions and road closures around the new workplace at the time of the survey were also among factors that could possibly discourage the drivers to commute by car. Compared to the former literature, our study additionally shed light on the commute satisfaction impacts of a workplace relocation. Similar to our positive travel mode switching results, we observed a significant increase in commute satisfaction after the relocation. Our findings revealed that commute satisfaction and mode choice not only can mutually influence each other but can also be influenced independently by some determinants which are explained in more detail in Chapter 4.

Complementing the examination of the objective determinants of mode choice investigated in the fourth chapter, **Chapter 5** focused on the rationales underlying commute-related choices and changes by looking at the complex causal relationships between subjective factors including attitudes and values, dissonance and satisfaction. This Chapter analyzed mode-specific attitudes for six modes (car, train, metro, bus, bicycle, walk) for the 1,977 respondents of the above-mentioned quantitative survey and conducted a qualitative analysis of 19 individuals who were recruited from those participants. By examining the mode-specific attitudes results indicated that among dissonant commuters, bus users constitute the biggest share and metro users the smallest. Surprisingly and contrary to the results from previous studies, the share of dissonant active mode users was relatively high compared to other modes (except bus). Mode-specific attitude score for bicycle was also lower than metro and train. These findings can be, at least partially, accredited to: 1) the accessibility of metro and train services at the Glen site compared to the five older MUHC

sites; 2) the relatively insufficient accessibility for bike riders due to road closures and constructions, congestion, and the existence of the highways that surround the Glen site. Furthermore, we found that whereas 80% of the respondents are consonant, 70% of the respondents are satisfied commute-wise, showing that there still exist consonant commuters who are unsatisfied with their commute (we also found dissonant but satisfied commuters). Dissonance-satisfaction suggests that people can have relative preference for more than one mode or their satisfaction results from non-mode-related domains such as home-work travel route or time or a friend who accompanies them. Consonance-dissatisfaction can be an outcome of a temporary inadequacy related to the mode used (e.g., road closures, temporary out-of-service train facility) or due to dissatisfaction vis-à-vis non-mode travel attributes (e.g., route, direction (towards/against traffic congestion), distance, departure/arrival time). Through 19 face-to-face interviews we also investigated how individuals adapt commute-related domains of life in order to maximize their life satisfaction when experiencing a change of workplace. In conformance to the quantitative findings, the in-depth interviews revealed that a dissonance between the choice of a commute mode and attitudes towards that mode does not always mean that the mode used is the non-preferred one. Even though a certain mode might be the most preferred one (in an ideal situation), individuals might choose the second-best transport mode. This finding suggests that individuals make travel-related choices by attributing different value and attitudinal weights to their alternatives. As people have more than one travel(-related) attitude/value, it is not always feasible to behave in conformity to all of them. Instead, people are more likely to act upon the attitude/value which has the strongest weight among the others if their access (geographical access and socio-economic characteristics) and competences allow them to. The perspective of weighted decision-making helped improve understanding of that satisfaction in various travel-related domains are interdependent and each can affect or be affected by overall life satisfaction.

Finally, **Chapter 6** summarizes the findings of each manuscript and contextualizes them within the overall goal of this research. This chapter concludes by discussing the policy relevance of this research to urban-transportation planning authorities, how this research contributes to the knowledge of household's mobility decisions and satisfaction and concludes by proposing directions for future research.

Overall, this dissertation presents a set of complementary studies to fill the gap in understanding of individual's daily commute behavior and satisfaction in the context of a major involuntary workplace relocation. This dissertation also demonstrates the significance of using both quantitative and qualitative methods in travel behavior research. Finally, our deeper examination of individual's behavior was an attempt towards addressing the current challenges faced by professionals i.e., taking adequate policy measures to guide mobility towards a more sustainable future.

2. Chapter Two: Research Methodology

2.1. Introduction

This chapter explains the methodology implemented in this study to accomplish the research goals. This study aims to understand the choice of household's daily mobility in metropolitan territory by evaluating the performance of 10,000 employees (and their households) of the McGill University Health Center (MUHC) who experienced an involuntary relocation of their workplace to the Glen site (Montreal, Canada) in 2015. In the light of this we sought to expand our understanding of how individual's daily commute contributes to adapting different travel-related domains of life in order to increase their life satisfaction when experiencing a context change. Accordingly, the chapter is structured in six main parts. Following the introduction, the second section explains the research strategy, and rationalization for its implementation. Section three provides the research design for the study and outlines the procedure for analyzing the data to answer each research objectives. The fourth and the fifth sections respectively describe the "MUHC Survey" and the context of the project. Finally, section six describes the sample selection procedure among the MUHC employees who participated in the quantitative and qualitative surveys carried out for this research.

2.2. Research strategy

The goal of the research strategy is to define the path that we take to conduct our research study. Generally, to answer research questions three common approaches exist: quantitative, qualitative, and mixed methods (Williams, 2007). While quantitative approach often deals with numerical data and involves surveys and statistical analysis, experiments, or explanatory studies, the qualitative approach requires non-numerical data including visual images, interview and records of individual statements, and documentation of real events.

According to Williams (2007, p. 66), in quantitative research, "the research itself is independent of the researcher. As a result, the data is used to objectively measure reality." The three broad classifications of quantitative research named by Leedy and Ormrod (2016) are descriptive, experimental, and causal comparative. The descriptive research involves the examination of the situation in its present state and identifies the attributes of the studied phenomenon or the

relationship between two or more phenomena on the basis of observations (Williams, 2007). The experimental research examines the influences of an intervention into the study sample and then evaluates the outcomes of the intervention. The causal comparative research provides the researcher the opportunity to investigate the cause-and-effect relationships between the independent and dependent variables and how the former can influence the latter. To conduct each of these categories of quantitative research various methods exist including correlational, developmental design, observational studies, and survey research. These methods can also be combined when conducting more complicated studies. For instance, in social sciences research a survey can be employed cross-sectionally or at different stages over time (i.e., longitudinally) for capturing information from respondents (that are representative of a population), and then the researcher investigates the statistical correlation between the studied variables (Creswell, 2014; Williams, 2007). Where the study is conducted using information on events that have taken place in the past, a retrospective study should be performed, as in the present dissertation.

Contrary to the quantitative research, qualitative research is often built upon inductive reasoning of the researcher and requires him/her to be highly involved in the actual experience and describe, explain and interpret the collected data (Creswell, 2014; Williams, 2007). Qualitative research can be conducted through five main methods each of which can meet different research needs: case study, grounded theory study, ethnography study, phenomenological study, and content analysis (Leedy & Ormrod, 2016). For instance, for in-depth exploration of a person, activity, process, and event and obtaining patterns that connect with theories or deriving a theory grounded in the views of the studied participants case study and grounded theory are suitable methodologies (Creswell, 2014; Williams, 2007). Researchers who attempt to study cultural-sharing behaviors of an entire group over a prolonged period of time may focus on ethnography method. Phenomenological study can also be employed to study individuals and their perception of an experience. Similar to grounded theory, this method requires interviews to be conducted, albeit lengthy (1-2 hours), in order to understand and interpret the essential meaning and structure of an event experienced by a participant. Finally, content analysis study is the best solution for “detailed and systematic examination of the contents of a particular body of materials for the purpose of identifying patterns, themes, or biases” (Leedy & Ormrod, 2001, p. 155).

Although quantitative and qualitative research methods are advantageous in many ways, some of their strengths, however, can be considered as weaknesses from another perspective. For instance, in quantitative studies, many important characteristics of people such as perceptions, emotions, and beliefs cannot be meaningfully reduced to numbers or adequately understood through survey questionnaires and without reference to the context in which people have lived their life (Choy, 2014). In addition, as effective quantitative studies often work with large sample sizes, lack of resources may make large-scale research of this kind impossible. With regards to the qualitative research, the major drawbacks are that the process is often time-consuming and requires a labor intensive analysis process such as categorization, recoding, etc. (ACAPS, 2012). During this process a particular issue is likely be overlooked whereas another important issue can go unnoticed. As researchers' interpretations are related to their knowledge and personal experience, various observations and conclusions may result from one single phenomenon. Finally, since qualitative surveys are generally open-ended, the participants have more control over the content of the data gathered which can be problematic in some respect (Yauch & Steudel, 2003).

Following the developments of first the quantitative and second the qualitative research (Tashakkori & Teddlie, 2003), mixed methods emerged as the "third research paradigm" in 1950s (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 1998). Mixed methods approach enables researchers to incorporate methods of collecting and analyzing both numerical and narrative data, which is customary for quantitative and qualitative research respectively, in a single research study (Creswell, 2014; Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2003). This allows researchers to apply deductive and inductive evaluations to test and build theories in the same research while bringing the strengths and reducing the weaknesses of the quantitative and qualitative approaches as each approach will complement the other. For instance, closed-ended questions of a survey questionnaire in a quantitative study can be examined in more detail using open-ended questions of an interview in a qualitative study. Finally, considering not only the strengths and weaknesses of each research method, but also the available geographical-temporal limitations, financial resources, and researcher's skills in each method, the researchers should choose the best research design in order to address their research problem and objectives most effectively (Creswell & Poth, 2018).

2.3. Research design

Taking into account the aforementioned considerations, we found the mixed methods approach as the most suitable research strategy for achieving our research objectives. A thorough execution of a case study also provides various advantages in this study. First, its closeness to real-life allows for analyzing the complexity associated with decision-making process because it deals with information collected directly from the decision-maker individuals themselves, those who have actually lived the experience/event under investigation, hence, can report (through a written questionnaire or verbally) their choices and explain the related logic, reasoning, feelings, etc. Second, contrary to a conventional wisdom that questions the reliability and validity of case studies (see, e.g., Campbell, 1975; Flyvbjerg, 2006), the case of MUHC helps produce context-dependent knowledge that will enrich research that considers geographical and cultural factors as fundamental elements in understanding travel behavior (De Witte et al., 2013). Third, the extensive scale of the chosen case study in addition to the sample selection method (explained in Chapter 4 and 5) allow to generalize the results and add value to the previous travel behavior research by either corroborating with or questioning their findings (Flyvbjerg, 2006). Finally, not only the case study allows for testing current hypothesis in mobility behavior (e.g., good access to public transit increases the probability of its use), it helps generate new hypothesis to be tested in future studies. Through the next chapters, especially chapter 5, the analysis of the results will leave scope for readers (even of different disciplines) to make different interpretations and draw diverse conclusions and open new avenues for future research.

Considering that the relocation of the MUHC was indeed accompanied by mergers of five old hospitals (situated in different locations in downtown Montreal) into the Glen site (located southwest of the downtown a few kilometers (~5km) from the old sites), the data collection was performed using a retrospective approach in three major steps[3]: A systematic review of the literature on mobility impacts of workplace relocation formed the basis for the first paper which

[3] The first step (2016-2017) included examination of the economic and spatial accessibility (i.e., travel-time, cost, distance) of the current and previous hospitals (4 old and 1 new) by various modes of transportation. These measures were acquired using GIS, statistical analysis, and the most recent Origin-Destination Survey of the Montreal area. This part was mainly carried out by other collaborators of the MUHC Research Project (named in the acknowledgements) and the results are used as the basis of my investigations in the next steps.

was published in the Journal of Planning Literature in 2017 (Chapter 3). This step laid the groundwork for the second step (2018), an internet survey (online questionnaire) which collected the data on the current and previous commuting habits, residential location, car ownership status, and commute-related needs, experiences and priorities of the employees and their households along with their barriers of using low-carbon transport modes for home-work trips. On May 2018, the internet survey was launched among the 7500 employees[4] and a response rate of around 26% (N=1977) was observed. The third stage (2018-2019) was conduction of a qualitative survey in which 19 employees were recruited from those who had completed the online questionnaire and participated in a one-hour face-to-face interview. Whereas research in the field of travel behavior is dominated by quantitative analyses, few studies have applied mixed methods approach where a qualitative survey provides a deeper insight into the complex causal relationships between subjective psychological concepts that quantitative methods are often unable to address thoroughly. For conducting both surveys, ethical approval was granted by the Research Ethic Committee at University of Montreal. Written informed consent was also obtained from all participants. The results of this step were also published in the Journal of Sustainability (Chapter 4 and 5).

The first research aim was to identify factors that affect travel behavior in general and commuting behavior in particular. To achieve this aim and to gain a deeper understanding of modal choice, we reviewed the relevant literature with emphasis on how modal choice can be defined and on the determinants that can influence the modal choice decision process. Then we carried out a systematic literature review concerning the mobility impacts of involuntary workplace relocation and examined which modal choice determinants play more significant role in commute mode change (or not) following the relocation. Results from this review built the foundation for our second research aim which was the exploration of the mobility performance (particularly daily home-work travels) of the 10,000 employees (and their households) of the MUHC who experienced an involuntary relocation of their workplace. To achieve this aim, a series of descriptive analysis and regression models were conducted in order to model the link between

[4] Even though the relocation of the MUHC in 2015 affected the commuting habit of more than 10,000 employees, the approximate number of regular occupants working at the Glen site is around 7500. This figure takes into account the fact that a predictable percentage of employees are on long-term illness/maternity leave or on vacation at any given time.

commute mode choice and socio-demographic characteristics, residential mobility and car ownership decisions, travel attitudes, and commute satisfaction[5]. The third research aim was to examine how individuals adapt commute-related domains of life in order to increase their life satisfaction when experiencing a change of workplace. To achieve this aim, we conducted semi-structured interviews to acquire a deeper insight into the complex causal relationships and rationales underlying travel-related choices and changes, attitudes and values, and satisfaction. Although quantitative data in general potentially allows for examining causality, online questionnaires, even those with retrospective questions, as in the present study, are less capable of understanding changes and processes over time compared to longitudinal data. One reason is that lengthy questionnaires that contain detailed questions regarding various aspects of causality are time-consuming and can cause participant frustration and drop out. In the present study, the online questionnaire was relatively extensive since it concerned the situations of the respondents both before and after the move. Therefore, discovering the complex relationships and interactions between the mobility determinants that are shaped throughout the time requires the use of qualitative methods as a complementary approach that allows for the in-depth evaluation of such subjective and relative concepts.

2.4. Description of the survey

The study was conducted in two steps: (1) online questionnaire; (2) face-to-face interview. The conduction of both surveys was completed with the collaboration of the human resource leadership at MUHC who assisted us, the research team (at UdeM, McGill, Polytechnic and Concordia Universities), in including the most effective and relevant mobility questions in our survey and in examining the understandability/suitability of the online survey's questions with volunteer employees prior to launching the original survey. The self-completion retrospective questionnaire was designed as a web form with LimeSurvey© and published online in both the English and French languages. In order to encourage the employees to participate, the survey was announced through digital ads illustrated on screens inside the complex as well as the internal website of the

[5] Prior to this step, we conducted a pilot study on the mobility impacts of residential relocation of households who have had moved their residence during the last two years prior to the survey. This study not only helped us to examine the modal choice determinants following a context change other than workplace but also enabled us to acquire an overview of the drawbacks and potential challenges that we might have faced with the MUHC survey in the next few months.

MUHC. One week prior to the launch of the online survey, the employees received an email regarding an upcoming email about the survey, in which the aim and scope of the corresponding research was explained. The employees were asked to check their inbox on the determined date. On 14 May 2018, (approximately 7500) employees of the MUHC were invited via email to participate in the online survey questionnaire. The email included a link that directed them to a web-based questionnaire, which typically took approximately 20 to 45 minutes to complete. The project was announced as a study on "understanding the consequences of relocation of the MUHC to the Glen site". The invitation email was sent for the second time after one week as a reminder to those employees who did not have a chance to complete it.

Participants completed the extensive questionnaire, detailing sociodemographic information regarding themselves and their co-residents (age, gender, education, income, number of household members, and car ownership before and after the move); their occupation, old place of work and old and new work schedules; their place of residence (old and new if changed since 2002 when the MUHC officially announced the relocation); their home–work journey characteristics before and after the relocation (modes, time, frequency, cost, and parking at work); their trip chain and activity spaces (kid's pick up/drop off, shopping, leisure activity, etc.); their level of overall life satisfaction as well as travel-related satisfaction including accessibility and distance to home, public transport and amenities; their perception about each mode of transportation; reasons for choosing their current home and others.

On the last page of the online questionnaire, respondents were asked to provide their email address and/or telephone number if they are interested in being contacted for a face-to-face interview. A total of 101 respondents provided their contact information—of which, only 19 consented to participating in a one-hour long interview. The interviews were conducted between September and December 2018 with 19 employees at the Glen site.

2.5. Context of the project

The relocation of the McGill University Health Center (MUHC) (Montreal, Quebec, Canada) took place between March and June 2015. More than 10,000 employees (including doctors, specialists, nurses, technicians, service jobs, etc.) were progressively relocated from five hospitals (Montreal General Hospital, Montreal Children's Hospital, Montreal Victoria Hospital, Montreal Chest

Institute, Montreal Neurological Institute) in the downtown core to a new site, called the Glen site, located southwest of the downtown a few kilometers (~5km) from the old sites. The new complex is situated next to the Vendôme intermodal station which includes a bus terminus, a subway and a suburban train station, and not far from a motorway interchange serving two highways (A20/A15) structured at the national level. Therefore, the site is quite accessible by both private and public transport; however, the existing road network together with the ongoing highway constructions bear variable traffic conditions especially during peak hours (CIMA+, 2011; Dessau-Soprin, 2005). The MUHC complex includes multi-level parking with electric vehicle charging facilities for the employees and ample underground paid parking for patients and visitors.

With a small-town population size (including patients and their families in addition to the employees) the MUHC super-hospital is a significant trip generator/attractor which plays a prominent role in the mobility debate. It is not only a spatial entity but also one with a unique temporal ordering for many people travelling to/from it because it is effectively a mini 24-hour society. It is composed of employees with various job categories including administration professionals/technicians, health and social professionals/technicians, doctors, nurses, and service and volunteer staff. This diversity not only creates an exceptional situation regarding generating typical and non-typical commute trips (e.g., for those who work during the night or weekends) but also has significant implications for transport mode usage which can explain the hypothesized differences in behaviors of employees in different occupation categories.

2.6. Sample selection

As the employees of the MUHC had no control over the decision to relocate their workplace, the self-selection processes are unlikely to influence the link between commute behavior and the new built environment (Vale, 2013)[6]. In other words, the employees had to accept the new home–work distance as well as access to the transportation opportunities. Nevertheless, it should be noted that some employees may have decided to leave the MUHC rather than relocating to its new location for different reasons including because the change meant that the commuting mode, time, or cost became unacceptable. On the other hand, some employees joined the MUHC after its relocation

[6] The relocation of the MUHC was officially announced in 2002 meaning that for more than 10 years the employees where aware of a future workplace relocation.

to the Glen site. Although these individuals experienced a change in workplace, we could not include them in our analysis because the relocation of the MUHC did not have a role in the change (or not) of their commute. Therefore, we limited our analysis to the impacts of the relocation on those who worked for the MUHC both before and after its move and who commute to and from the Glen site at least two days a week.

3. Chapter Three: Toward more Sustainable Behavior: A Systematic Review of the Impacts of Involuntary Workplace Relocation on Travel Mode Choice

3.1. Overview of the Chapter

Daily home–work travel is a habitual behavior that can be disrupted when the location of work, as one of the behavioral contexts, changes. It is then likely that individuals will reconsider their travel behavior more intentionally and choose alternative transport modes. To identify motivations and barriers to incorporating the use of sustainable modes into the individual's daily travel, this paper systematically reviews the literature on the impacts of involuntary workplace relocation on commuting behavior. Effective measures that incentivize sustainable commuting behavior are also discussed. This study on involuntary workplace relocation informs considerations of changes in travel behavior related to other contextual changes.

3.2. Introduction

Involuntary workplace relocation can happen when one or multiple job organization(s), at one or multiple location(s), move or merge (in)to another location. From the standpoint of the employees, who have very little part in initiating or controlling the move, this relocation is an exogenous life event that can influence their commuting behavior as well as their overall daily mobility. Whereas there is a small body of work about forced job relocations, other life events such as the birth of a child, residential relocation, job changes, and mobility tool ownership, i.e., purchasing or disposing of a car, bike, or public transit ticket, have received a great deal of attention in the literature on mobility biographies.

During the past few decades, the concept of mobility biographies has garnered considerable attention in social-scientific research and practice, reflecting the increasing awareness of the transportation planning opportunities that lie behind behavioral changes triggered by key life events (Beige & Axhausen, 2012; Clark, Chatterjee, et al., 2016b; De Groot et al., 2011; Diewald & Mayer, 2009; Lanzendorf, 2003, 2010; Müggenburg et al., 2015; Scheiner, 2014; Scheiner & Holz-Rau, 2013a; Schoenduwe et al., 2015). Mobility biographies focus on life events that can induce alterations in spatial context, lifestyle preferences, and travel behaviors (Clark, Lyons, et

al., 2016; Scheiner, 2007). It is suggested that when travel habits are disrupted, attentiveness to alternative modes increases, and thus, behavior is more likely to be deliberately reconsidered (Müggenburg et al., 2015; Stanbridge et al., 2004; Verplanken et al., 2008). From a planning perspective, these moments are great opportunities for introducing and encouraging the use of sustainable transportation alternatives and for promoting health and environmental concerns.

One notable life event that can induce contextual and travel behavior changes is relocation. Whether it is for personal or professional reasons, uprooting and moving to another location is a complex event from a social and psychological perspective. It exposes people to a novel situation in which their habitual coping skills may be ineffective (Hausman & Reed, 1991; King, Dimond, & McCance, 1987). Relocation causes alterations in various life dimensions, particularly daily mobility, which accounts for major daily life arbitration in a household (Schönfelder & Axhausen, 2010). Among all types of daily displacement, commuting journeys, i.e., daily home–work trips, account for a significant proportion of personal travel and are of particular importance in transport planning due to the following reasons: Morning and afternoon rush hours derive the demand for capacity in road infrastructure and other transportation services, which together make up the urban network (Levinson & Krizek, 2008). Additionally, commuting journeys play a frame-setting role for daily mobility by being much more regular and consistent than shopping and social trips (Manaugh et al., 2010; Shearmur, 2006). Last but not the least, excessive dependence on cars for commuting trips, relative to other transport modes, carries significant social and environmental costs, including greenhouse gas emissions, construction and maintenance of dense road networks, provision of parking spaces, time loss in traffic congestion, negative externalities on health. (Sprumont et al., 2014).

Conceptual model of daily home–work travel

De Witte et al. (2013) explain how making a choice for daily travel engages individuals in a very complex decision-making process involving an extensive variety of factors from various disciplines including economics, sociology, geography, and psychology. Figure 3.1 presents a conceptual model to illustrate that mode selection for home–work trips is determined by a whole range of physical and psychological (objective and subjective) factors that are interrelated, to a greater or lesser extent, and that involve the spatial characteristics of both home and work

locations. The interconnections between indicators corroborate that commuting behavior often results from a compound decision-making process that is performed consciously or unconsciously, and habitually or intentionally, and that depends on one's access and competences (Kaufmann, Bergman, & Joye, 2004). Access refers to the range of mobility alternatives and is limited by spatial, temporal, and other contextual constraints. Accessibility to mobility options is a function of factors such as cost, logistics, weather conditions, etc., and is highly dependent on the actors' socioeconomic characteristics. Competences refer to the skills and abilities required to make use of access; these include physical abilities, acquired skills, and organizational skills. From the various possibilities, i.e., access and competences, a commuter decides on a transport mode based on their psychological characteristics (Van Acker, Van Wee, & Witlox, 2010). In other words, commuters interpret and evaluate their travel options both at home and the workplace, and then react, based on their habits, preferences, attitudes, and other factors. Kaufmann et al. (2004) refer to this as the appropriation phase and suggest that the individual's interpretation varies based on their needs and aspirations, which are inherently linked to their motives, attitudes, values, and habits. Appropriation helps to explain how different choices are made when access and competences are identical among different individuals. It also elucidates the "irrationality" of travel behaviors when decisions are not based on utility maximization attainable by minimizing travel time and costs (Manaugh & El-Geneidy, 2015). It is, indeed, the complex relationship between these attributes that can explain the large amount of variation in commuting behaviors.

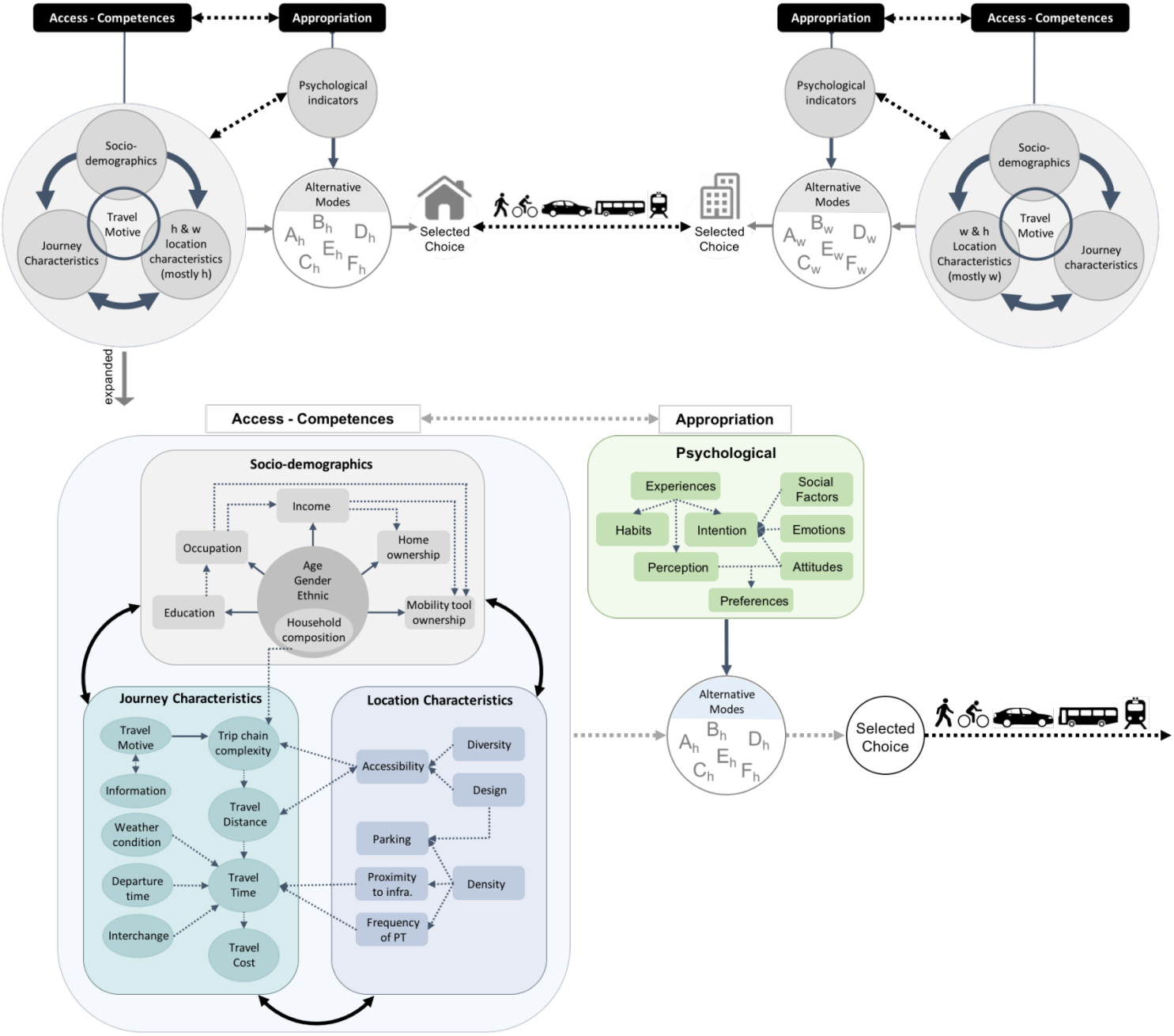


Figure 3.1 Conceptual model of daily commute mode choice – Up: h stands for home and w stands for work. Down: Capital letters subscripted by 'h' and 'w' refer to alternative travel modes available at home and work locations, respectively – Source: Author; inspired by De Witte et al. (2013) and Kaufmann et al. (2004).

Countless conceptual and empirical studies have tried to explain travel behavior changes from the residential environment perspective, which is often considered the trip origin (e.g. Bohte, 2010; X. Cao, Mokhtarian, & Handy, 2009; Reid Ewing & Robert Cervero, 2010; Krizek, 2003; Schwanen & Mokhtarian, 2005). Much less is known about the influence of destinations on daily

mobility, whereas travel behavior is highly affected by the land-use and transportation characteristics of the traveler's destination(s), particularly the location of work (Chatman, 2003; Clark, Chatterjee, et al., 2016b; Scheiner & Holz-Rau, 2013b; Vale & Pereira, 2016). It is suggested that employment centers with high accessibility to quality public transport stimulate a switch away from car commuting, and that mixed land uses at work locations encourage a mode shift to walking and cycling. Apart from this, home and work can be experienced as both the origin and the destination entity, and thus, commuting behavior is a function of both home and work location characteristics, at almost equal weights. In addition, subjective experiences develop not only in relation to the geographical space of the place of residence but can also be formed by a constant presence in the workplace, its surrounding urban environment, and transportation services. People do not only develop, reaffirm, and change their self-conception by means of daily travel and activities in the home settings (Feldman, 1990, 1996). A large part of their integration in social groups, the role they play in broader society, and thus their evaluation of their own unique self, can be developed and formed in their workplace (Hassan, 2012). Therefore, in a similar way to residential relocation, identifying the physical and psychological changes experienced during the period of a workplace relocation can help us understand the complexity of the travel-related decision-making process.

Finally, ignoring job location factors can lead to an over- or underestimation of the impacts of the built-environment characteristics of the trip origin (home location) on commuting behavior. Where job relocation takes place "involuntarily," as in the merger of several organizations into a single employment site, a large community of employees and their households are likely to experience more significant or unexpected changes regarding their daily mobility, as compared to voluntary job relocations. Furthermore, it is not always feasible to intervene in residential environments to moderate travel behaviors, due to economic restrictions and the size and scale of the territory to be considered.

In this context, the main aim of this paper is to review studies that provide insight into 1) the factors that affect sustainable commuting decisions when an involuntary workplace relocation impacts the home–work travel patterns of a large community of employees, and 2) how this understanding can help practitioners and policy makers to develop effective measures to incentivize sustainable commuting behaviors, i.e., less automobile dependency and more public and active (walking and

cycling) transport use. The outcomes of this article are of high practical relevance, especially with respect to sustainable-travel demand management. The underlying principle is to derive benefit from identifying the motivations and barriers to using green transport modes when behavioral contexts change and to offer new transport opportunities in situations where there is increased attentiveness to alternative modes.

The remainder of this paper is organized into four parts. Section 3.2 describes the methodology used to select the relevant literature that is reviewed. Section 3.3 presents the results of the review: first by discussing the data collection and methods used by the selected papers; second by categorizing the papers into different groups; and finally, by summarizing and analyzing the factors that affect commuting behavior following a workplace relocation, based on the conceptual model. Next, the paper discusses key findings and makes recommendations for encouraging sustainable travel behavior and presents the strengths and weaknesses of the current evidence (Section 3.4). Finally, suggestions for future research are provided (Section 3.5).

3.3. Research Methodology

Search strategy and data extraction

A search of six electronic databases (Urban Studies Abstracts, Scopus, Web of Knowledge, Transportation Research Board archives, Transport Research International Documentation, Google Scholar) was undertaken. The search syntax was limited to terms for travel and terms for workplace relocation, as outlined in Figure 3.2. The study searched for published and unpublished reports from the earliest possible start date to February 2018 and limited the language of publication to English. Studies were included and excluded according to the following criteria: they were included if they (i) investigated the impacts of involuntary workplace relocation on employees' commute mode choice;[7] (ii) compared before and after journey-to-work characteristics of workers; and they were excluded if (i) job relocation was voluntary or a result of preceding life events such as residential relocation; (ii) commute mode shift was a result of other life events such

[7] In this study, the concept of relocation includes a range of displacement distances, from a few kilometers, or intra-metropolitan relocation, to long distances (several hundred kilometers), or intra-country or intra-regional displacement of one workplace or mergers of multiple organizations. The word "workplace," also refers to a range of location categories including firms, offices, organizations, industrial companies (Figure 3.2).

as external interventions in land use, and transportation characteristics of the home or work location. No study was excluded on the grounds of research design, study population, or type of relocated job. The study evaluated the identified articles on their suitability for data extraction, first by screening the abstract, and then eventually by reading the full text (Scheepers et al., 2014).

In total, the search strategy resulted in 1452 records—1316 after removal of duplicates. Based on the examination of the titles and abstracts, 1242 publications were excluded. Of the remaining 74 publications, full texts were retrieved, thoroughly read, and again evaluated with regard to matching the inclusion and exclusion criteria. A total of 54 studies were excluded, which left us with 20 studies. In addition, the reference lists of all 74 publications were screened, which resulted in 2 additional studies. In total, 22 publications were eligible for data extraction.

NO	Search expression
1	FT=(job*;job location*;work*;workplace*;work location*;employment location*;employment site*;office*;company*;factory*;manufactory*;enterprise*; plant*;organization*;mill*;occupation*;profession*;labour*)/TI
2	FT=(job;work*;office;employ*;occupation*;profession*;labour*; company*;factory*;manufactory*;enterprise*; plant*;organization*;mill*) /(TI;AB) CT=(move*;relocat*;chang*;merge*;mobil*;access*;displac*;migrat*;decentralis*;suburbanis*)
3	FT=(commut*;home–work*;travel*;transport*;mobilit*;commuting behavior*;commute behavior*;commuting behavior*;commute behavior*;commuting habit*;travel behavior*;travel behavior*;travel habit*;journ*;trip*;mode*;modal; mode choice*)/(TI;AB;CT;UT)
4	FT=(modal;mode*)/TI AND FT=(analys*;analyz*;choice*;distribution;effect*;selection*;shift;split*;substitut*;switch*;transfer*;transport*;use*)/TI
5	FT=(transport*;travel)/TI AND FT=(behavior;behavior;chang*;demand*;habit*;impact*;pattern*;shift*;substitut*)/TI

Figure 3.2 Search strategy abbreviations: FT= free term, TI= title, AB= abstract, CT= controlled term, UT= uncontrolled term, *= truncation sign: stem word + all possible endings

From the included studies, information was extracted regarding (i) study characteristics: year of publication, location of study, study population, and response rate; (ii) methodology, including number and time of surveys; (iii) before-the-move and after-the-move transportation and land-use characteristics of the employment locations (N.B.: these variables include density, diversity, design, distance, and availability, accessibility, and quality of transportation services and surrounding activity opportunities); (iv) socioeconomic and psychological characteristics of the

respondents; (v) results and significance by evaluating the link between identified variables and commute mode shift.

This systematic review is carried out in the form of a narrative review rather than a meta-analysis. Since the number of published studies on this particular topic is small, and the scale and context of the relocation projects vary substantially, a significant statistical analysis was not feasible. Performing a meta-analysis requires that the researcher make choices that can affect the results, including selecting a large number of studies based on a set of desired objective criteria. This is often possible when a statistical overview of the results from one or more systematic reviews is carried out. Therefore, this narrative review relies on the interpretation of results made by the authors of the selected papers, without any opportunity for the current authors to question them.

3.4. Findings

Based on the changes that took place in the land-use and transportation characteristics of the new employment locations, the reviewed studies fall into three categories (Table 3.1): 1) relocations from the Central Business District (CBD) to a suburb or subcenter—nine cases; 2) relocations from a suburb or subcenter to the CBD—two cases; 3) relocations within the city (or relocations associated with insignificant changes in the site's land-use and transportation attributes)—twelve cases.[8] No study was found on workplace relocation from a non-CBD location to another non-CBD location.

This review of the literature is not geographically constrained, and papers from different continents have been included. The majority of the papers come from Europe (12), but studies from North America (3), Australia (3), and Asia (4) are also included. The logic behind the inclusion of studies from different regions is that assessing a variety in the built environment and transportation supply of cities with developed CBDs as well as a variety of people with different sociocultural traits will provide more valuable and inclusive results.

[8] In one study (Aarhus, 2000), the first and the second categories of relocation are both investigated. Therefore, although 22 papers are included in this review, 23 cases are discussed (Table 3.1).

3.4.1. Data collection and methodological approaches

Among the 22 reviewed papers, the collection and analysis of the data vary based on the studies' research questions and the projects' scale and geographical context. Some studies, such as Cervero and Wu (1998) or Aguiléra, Wenglenski, and Proulhac (2009), used census data to evaluate the impacts of employment suburbanization on a regional scale as a long-term trend rather than focusing on a single workplace relocation as do Waygood, Kitamura, and Nakai (2007) or Walker et al. (2015).

In ten studies (Aguiléra et al., 2009; Bell, 1991; Hanssen, 1995; Meland, 2007; Sprumont & Viti, 2017; Vale, 2013; Van Wee & Van Der Hoorn, 2002; Walker et al., 2015; Waygood et al., 2007; Yang et al., 2017), surveys were carried out before and after the relocation, while the rest of the studies used retrospective surveys or collected information through interviews with representatives of the companies or by reviewing the relevant planning documents. Some studies collected commute behavior information using a general classical travel survey, while others, such as (Hanssen, 1995) and Sprumont and Viti (2017), collected commute mode choice information using a one-day and a two-week travel diary, respectively.

Some older studies mostly relied on descriptive analyses (Bell, 1991; Daniels, 1972, 1981; Wabe, 1967), whereas some more recent studies had a focused research objective leading to a specific data collection process and less conventional methodological approaches (Sprumont & Viti, 2017; Walker et al., 2015; Yang et al., 2017). Few studies used statistical models and exploited the data to identify the explanatory variables of the observed impacts on commuting behavior (Sprumont & Viti, 2017; Sprumont et al., 2014; Vale, 2013; Yang et al., 2017). Yang et al. (2017) applied multinomial logit models, with revealed and stated preference data to explain the variation between anticipated and actual travel mode choice. Using standard deviational ellipses (SDE) combined with cluster analysis, Sprumont and Viti (2017) also tried to capture activity spaces of a group of university employees whose activity-travel routine was disrupted to a great extent. Finally, Burke, Li, and Dodson (2011) applied a long-term forecasting approach and discussed different decentralization scenarios for the year 2031, using strategic transport modeling to estimate aggregated modal shares, vehicle kilometers traveled, and vehicle hours traveled. For detailed information, including rates and percentages, refer to Table 3.1.

3.4.2. Relocations associated with significant changes in land use and transportation

Relocation from CBD to suburb or subcenter

Nine studies concerned transportation changes caused by employment suburbanization/decentralization, which started to occur as a subsequent phase of residential decentralization or urban sprawl, noticeably from 1960s (Aarhus, 2000; Cervero & Landis, 1992; Cervero & Wu, 1998; Daniels, 1972, 1981; Fernandez, 1994; Parolin, Bickerstaff, Edenhofner, & Tinker, 2001; Wabe, 1967; Waygood et al., 2007). From this date onwards, a number of studies in the United States and the United Kingdom devoted attention to changes in the journey-to-work as the most dramatic consequence of employment decentralization. A common observation concerns the significant increase in the average commuting distance, referred to variously as "wasteful commuting" (Hamilton, 1982), "jobs-housing imbalances" (Bookout, 1990; Cervero, 1989), and "spatial mismatches" (Kasarda, 1988)—the impacts of which were greater on residents of the city center who experienced reverse commute. This dramatic change, in addition to inefficient accessibility of public transit, induced significant shifts from active transport, mass transit, and collective forms of travel to drive-alone automobile travel. In a study from London, UK, accessibility to public transit was difficult, even for suburban residents, as the new employment site was located almost a mile from the center of the suburban town where the train station was situated (Wabe, 1967). Since the new suburban employment sites were typically office parks outside the urban core and poorly planned as regards accessibility to public transit and services, these results were not unexpected. However, it should be considered that the increased share of private transport was partly a product of the secular trend towards car ownership in that era (Daniels, 1981).

Relocation from suburb or subcenter to CBD

Only two papers fall into this category (Meland, 2007; Van Wee & Van Der Hoorn, 2002). Both studies highlighted reduced access (80% reduction reported in Meland (2007)) to free car parking and increased access to public transport as the principal underlying factors for a mode shift from private to public transport.

There are three main reasons why this category includes a smaller number of studies. Workplace relocations 1) often follow on the phenomenon of urban sprawl, moving jobs closer to workers' residences (Cervero & Landis, 1992); 2) aim at reducing peak-hour commute trips and traffic congestion in the urban core (Yang et al., 2017); 3) are usually associated with company expansion as a result of organizational mergers, hence requiring larger tracts of land, which are often unavailable or inaccessibly priced in CBDs.

3.4.3. Relocations associated with insignificant changes in land use and transportation

Twelve cases concerned workplaces that moved from one or multiple addresses to one joint location, all within the city center or from the CBD to a similar peripheral area, as regards the transportation infrastructure and land use characteristics (Aarhus, 2000; Aguiléra et al., 2009; Bell, 1991; Burke et al., 2011; Hanssen, 1995; Loo & Chow, 2011; Sim, Malone-Lee, & Chin, 2001; Sprumont & Viti, 2017; Sprumont et al., 2014; Vale, 2013; Walker et al., 2015; Yang et al., 2017). Seven studies showed almost no positive effect on commute mode shift. Although in most cases the new sites were centrally located and linked to the transport network, many factors hindered their accessibility. For instance, the rail station was not on a line with frequent trains, in contrast to the former locations, which were well served by public transport (a main station on a main line) and with office buildings situated within a few minutes' walk of the station and of major activity opportunities.

The rest, on the other hand, reported a mode shift in the opposite direction, mainly as a result of relocation to a formerly planned site where intense commercial centers surrounded by high-density housing were integrated with efficient public transport systems. In one case, where relocation took place within the city, lack of car parking spaces at the new workplace induced more public transit use by commuters, even though public transit accessibility and quality remained unchanged (Aarhus, 2000). Walker et al. (2015) indicated that an 18-minute-shorter walking distance to public transit, when other variables are unchanged, can result in a 37% increase in public transit use and a 33% decrease in car use. These findings imply that people are likely to continue their commuting habit or improve it to more sustainable ones if land-use and transportation characteristics are designed and planned in a way to stimulate this behavior.

3.4.4. Factors affecting commuting behavior changes during the process of workplace relocation

The included studies examined a variety of factors that affect commuting behaviors and relevant decisions during the relocation process. These factors are extracted and discussed below. According to the conceptual model (Figure 3.1), these factors are categorized into three groups: 1) location and journey characteristics; 2) socioeconomic characteristics; and 3) psychological factors. Table 3.2 indicates if each factor is related directly or indirectly to mode shift.

Location and journey characteristics

- *Transportation infrastructure and parking*

Nearly all studies indicated that accessibility and quality of public transportation infrastructure are positively related to a mode shift from private to public transport. Accessibility to a quality road system and arterial road network, on the other hand, was positively related to driving for work trips. Overall, 17 studies reported a considerable mode shift—up to 75%—from public transit to private automobile commuting. Although this modal shift helped a great proportion of workers to save substantial time on their work trips after the move, some studies reported travel time increases (Table 3.1). Jobs reporting staff-travel problems most frequently mentioned the inadequacy of public transport (to cope with peak hour demand), the need to transfer between modes, and, occasionally, a complete lack of service in some parts of the office catchment area. One study also reported a noticeable disparity between office hours and public transport timetables, which resulted in discouraging many employees from using the service (Daniels, 1972).

In a contrasting case, Meland (2007) showed that the new job site gave easy access to the entire public transport system, including in the surrounding municipalities, whereas the old location solely provided bus service to and from the city center. This resulted in a notable reduction in car use even though free parking was available for more than 30% of the workers. Similar results were also found for a relocation followed by a shorter walking distance to the train station which led to a 37% increase in train use and a 33% decrease in car use (Walker et al., 2015). Aguiléra et al. (2009) also discovered that office decentralizations that take place adjacent to efficient rail and

bus facilities can reduce the proportion of private transport trips for companies with large numbers of managerial and professional staff owning one or two cars.

Nine studies evaluated the role of car parking availability on the likelihood of a mode shift towards car-based commuting (Table 3.1). Five of them found that accessibility to parking, whether free or not, was a stimulating factor for car-based commuting for a high share of travelers, even when jobs were located within walking distance of public transit. Aarhus (2000) and Bell (1991) indicated that the existence of parking spaces at new job sites increased the tendency for using cars, even among employees whose travel distance shortened after the move. Sprumont et al. (2014) found that a high monthly parking fee did not outweigh accessibility to a high-quality road system when the organization wanted to discourage driving to work. In a later study, Sprumont and Viti (2017) reported that despite a general increase in home–work distance, only 4% of respondents indicated a modal shift to the car. The authors relate this finding to the parking costs imposed at the new workplace. Finally, in cases where accessibility to efficient public transit was accompanied by a reduction in parking availability, employees were stimulated to choose public transport modes. This happened in three case studies where the workplaces relocated to an inner-city location (Aarhus, 2000; Meland, 2007; Van Wee & Van Der Hoorn, 2002).

- *Residential location and commute distance*

Ten studies looked at the relationship between workplace relocation and residential (re)location (Table 3.1). Five studies reported residential moves or future move intentions that were directly or indirectly related to the relocation of the workplace. Overall, studies suggested that for most commuters, a long home–work distance is less important than easy access to transportation and activity opportunities when choosing green modes over the car. In the cases of employment suburbanization, there was a dramatic shift (up to 75%) from public transit to car-based commutes, irrespective of the change in commuting distance, as home–work distance remained unchanged or even decreased in some cases. Ironically, findings from a sampling of decentralized offices throughout the UK by Daniels (1972, 1981) indicated that residential freedom at decentralized locations led to an increase in the use of private vehicles as a commute mode, at the expense of public transport. This finding suggests that long-term decisions, such as home relocation, do not always move in the direction of improving commute travel, as different people have different

priorities. In another example from Sprumont and Viti (2017), one respondent who already lived near the new workplace moved their home to a farther location because they didn't want to live and work in the same place. According to the theory of Redmond and Mokhtarian (2001), in this commuter's perspective, travel, per se, might have a positive utility. In other words, they gain more utility in a longer travel time than in residing close to workplace. (Redmond & Mokhtarian, 2001; Shen, Sakata, & Hashimoto, 2009). In a before-the-move study, Yang et al. (2017) reported that those workers who, after the workplace relocation, moved their residence closer to public transport anticipated using this mode more than those who moved their residence closer to the new workplace but far from a public transport service. However, the after-the-move survey revealed otherwise, as both groups indicated a statistically significant shift towards car-based commuting.

Overall, studies failed to discuss transportation and the land-use possibilities and constraints of residential areas. However, the essence of home and work can be experienced as both origin and destination entities, and thus, commuting patterns are characterized by both home- and work-location characteristics almost equally. Overlooking either home- or work-location factors can lead to an over- or underestimation of the impacts of the other location's built-environment characteristics on commuting behavior.

- *Trip chain and presence of activity opportunities*

One important factor that situated a considerable share of employees outside the comfort zone for active and public transport use, and induced them to switch to private automobile use, was the absence of activity opportunities at the new employment site (Bell, 1991; Hanssen, 1995; Meland, 2007). In some cases, the modal choice for commute trips was affected by whether or not the participant scheduled out-of-office tasks during the day. Therefore, a personal vehicle was required to perform business on the journey to and from work, or in the middle of the day. Moreover, "public transit is less convenient for complex trip chains whereas private car allows versatility and flexibility" Parolin et al. (2001, p. 4). Meland (2007) indicated that the use of the private automobile was positively related to having plans to do out-of-office tasks, probably because the parking fees were paid for by the employer on those days. A study from Melbourne, Australia, found a 10% reduction in the number of non-work daily errands per person at the new job site, as compared to the former inner-city workplace, which offered far greater opportunities such as

shopping and leisure (Bell, 1991). However, the number of trips to "serve a passenger" (e.g., taking children to school) increased as a result of switching to car use.

One unexpected result from the study by Parolin et al. (2001) was the slight increase in the number of recreational and social activities undertaken after the relocation from the CBD to suburb. Since the survey data provided no indication of the location of the activities, it was not possible to say whether an activity occurred close to the workplace or close to the residence. This may imply that the tendency to participate in activities may not be dependent on employment location. Sprumont and Viti (2017) investigated the employees' activity-travel pattern before and after the move. Using an SDE, the authors showed that after a considerable change of distance (20 km) between the old and the new workplace, the majority of commuters tended to keep their activity space close to home rather than either of the workplaces, particularly the former.

- *Relocation to planned sites*

In a study from Singapore, Sim et al. (2001) marked how land use characteristics can play a significant role in reducing the distance traveled and the reliance on cars for work trips as well as the number of commuting trips generated to the CBD. The authors indicated that workplace relocation to a planned regional suburban center resulted in 78% of workers using public transit for the commute, and only 5% using car. An efficient transport system connected the regional center to the Mass Rapid Transit (MRT), and several bus lines linked the area to the CBD and other parts of the island at a reasonable price. This different impact on modal choice, however, is partially related to Singapore's particular context, where urban transportation follows a different trend: generally, the vast majority of employees commute by public transport.

Burke et al. (2011) investigated the impacts on transportation of a planned decentralization of employment in Brisbane, Australia, by comparing the existing transportation model with that of the year 2031, which was proposed as the planning horizon. In contrast with most of the literature on decentralization, but similarly to the case of Singapore, this model suggested that strongly planned and guided employment decentralization may not be deleterious to public transit use if jobs are clustered tightly with key suburban activity centers, if transit links are more elaborate and interconnected, and if necessary, cross-suburban bus links are provided. It is, however, acknowledged that this study is a prospective study, and the actual impacts are not known.

A contrasting example comes from workplace relocation to a mixed-use transit-oriented center in the inner suburb of Lisbon, Portugal (Vale, 2013). The site was created with the express objective of creating a new metropolitan center (Carrière & Demazière, 2002), and the necessary transportation infrastructure was put in place. As a result, the site was very accessible by both private and public transport. However, despite a slight change in commuting time, the study found a significant increase in commuting distance and in car use. The results also revealed substantial car-use inertia, irrespective of place of residence. This demonstrated that people tend to maintain their commuting time within acceptable limits. Moreover, the number of active and public transport users considerably decreased, implying that the built-environment characteristics of the new location could not trigger the expected changes in employees' mobility patterns.

Socioeconomic characteristics

Studies that have taken socioeconomic variables into account are limited, as the majority of the studies were centered around modal shift as the main variable. A few studies, such as Waygood et al. (2007), controlled for the relationships between multiple variables including gender, household composition, commute cost, car ownership, and occupation, as well as different weather conditions and personal preferences. Most studies included a list of factors such as age, gender, ethnicity, occupational level, income, and vehicle ownership, but did not explain how each of these factors influenced commuting behavior during the process of job relocation. Meland (2007) and Waygood et al. (2007) reported that married/cohabitating participants with children aged 11 or under tend to have a lower degree of change than single commuters, who were more flexible in changing both modes of travel and residential location. Aguiléra et al. (2009) looked at the socio-professional status of the respondents. They indicated that accessibility to a subway and rapid transit system of sufficient quality resulted in a 15% reduction in car use and a 12% increase in public transport use by managers (high-income residents) who owned at least one car. On the other hand, car use almost doubled for low-income laborers, whose workplaces were in areas poorly served by public transport. Using a different approach, Fernandez (1994) and Cervero and Landis (1992) indicated that workplace decentralization negatively influenced ethnic groups and minorities, who preferred not to relocate their home after the suburbanization of their work; thus, their commuting distance, travel time, and cost increased.

One study highlighted the role of socioeconomic factors in mode choice decisions (Yang et al., 2017). Using stated versus revealed preferences (SP vs RP), the research found that, in reality, car availability and age are significantly related to the propensity to choose the car over other modes for the commute. Workers of mid-career age (26–35 and 46–55) showed a higher probability of choosing a car over a non-motorized mode than did workers just starting their career. Factors such as gender and income, having multiple wage earners, having a young child, and receiving a transport subsidy, which were expected to influence mode shift in the SP survey, were found to be insignificant in the actual mode choice setting.

Travel-related psychological factors

Similar to the socioeconomic characteristics, travel-related habits, perceptions, and attitudes of the target population have not been studied thoroughly and explicitly. Five studies reported that a majority of commuters found driving to be faster, more reliable, less expensive, more comfortable and convenient, and cleaner. In a case of employment suburbanization from Sydney CBD, Parolin et al. (2001, p. 8) found that 70% of respondents reported high levels of dissatisfaction with public transport services and mentioned that bus services were "infrequent, late, and crowded."

Workplace relocation, as an important life event, is associated with habit discontinuity and behavior change for different profiles of individuals. These research topics are complex, and the quantification and qualitative evaluation of their elements are difficult. Overlooking these factors, however, can lead to an over- or underestimation of the impact of the built environment's characteristics on commuting behavior. Walker et al. (2015) was the only study concerned with travel habit formation and decay during the process of office relocation, using the Self-Reported Habit Index (SRHI) method. The research found that travel habits were weakened immediately after the move (one week after), equally for those who changed modes and those who did not. However, in the third survey, which was carried out four weeks after the move, respondents showed stronger habits with regard to the new mode than they had immediately after the relocation. These observations indicated that pre-move habit strength and post-move habit weakness could not thoroughly predict or explain who changed behavior after the relocation. Additionally, demographic and attitudinal variables were found to be poor predictors of commuting behavior change. To this end, research on mobility does not provide concrete proof that internal cognition

or sociodemographic traits are stronger determinants of travel behavior after a workplace relocation than are spatial and infrastructural factors.

- *Anticipation of the workplace relocation*

Previous studies have found that anticipation of future events can affect travel-related decisions such as car ownership or residential relocation (Clark, Lyons, et al., 2016). For instance, people consider purchasing a car when expecting a child or anticipating a future increase in the home–work distance. The reason for this is that changes in car ownership require significant investments of time and money and only take place infrequently (Oakil, Ettema, Arentze, & Timmermans, 2014). In addition, factors such as car ownership levels, the number of household members with a driver's license, and car use in previous years are positively related to car ownership levels in the current year (Kitamura, 2009). Some life events are found to be more predictable than others; thus travel-related decisions are more likely to be taken in advance when these events are anticipated. Whereas, for other life events, decision-making usually follows the event (Oakil et al., 2014). Examples of these event types are childbirth versus home or workplace relocation. These lead and lagged effects help analyze temporal relationships between events, and thus, play a prominent role in individuals' decisions regarding mobility tool ownership after the relocation of their workplace.

Four studies concerned the anticipation phase, i.e., the time between the employer's announcement of the relocation and the actual occurrence of the move (Sprumont et al., 2014; Wabe, 1967; Walker et al., 2015; Yang et al., 2017). However, these studies failed to evaluate the impact of anticipation on the adaptation of mobility decisions (e.g., residential move, purchasing a car, etc.) that were possibly made by relocated employees. Walker et al. (2015) found that during the months between the announcement and the move, the company took various actions, such as offering enticing subsidy programs, to prepare staff for the relocation, with a focus on stimulating sustainable commuting after the move. However, after the relocation had taken place, the organization did not continue its pro-environmental travel behavior, as it paid the parking costs of those who continued to drive during the first six months. In the study by Wabe (1967), four years before the relocation, the firm announced the move and informed all workers who joined the company during that period. While this information was an enticement to join the company for those who found the suburban location a suitable and convenient workplace, some employees left

the company or moved their residence to shorten their commuting distance. Yang et al. (2017) reported that, in response to a hypothetical situation of the workplace being relocated to a new town, workers anticipated and chose commute modes almost irrespective of travel time, but largely based on their access and competence related to their sociodemographic characteristics. However, after jobs actually moved to the new town, workers' mode-switching decisions were predominantly made with regard to their actual travel time and place of residence. This finding implies that individuals may have an inaccurate evaluation of the enablers/limits related to their own sociodemographic characteristics. They may also show a lack of awareness of the full implications of their stated choices or an imprecise estimation of travel time and distance. To this end, it is recommended that when the anticipation of future travel behaviors is studied, personal constraints such as financial ability to afford a mode or physical ability to walk be taken into account.

3.5. Discussion

This systematic review tried to map the influences of forced workplace relocations on the commuting pattern and mode choice of the employees, by reviewing 22 studies. Identified factors include built environment characteristics (density; diversity; distance; transportation service at the workplace; and accessibility to activity opportunities, road systems, and parking spaces); travel-related psychological factors (mainly habits and perceptions); and socioeconomic characteristics. Among these factors, four were found to be more crucial in determining the share of employees who choose a private car as their major commuting mode following the relocation: 1) access to high-quality public transit, 2) access to (free) parking, 3) access to roads system, and 4) home–work distance. Findings imply that the impact on car use of access to parking and high-quality public transit (observed in fifteen studies) are focused on more than are the influence of access to road systems and the home–work distance (observed in ten studies). While the first two factors have resulted in up to a 43% and 75% modal shift, respectively, the maximum percentage reported for the latter factors is 7% in Cervero and Wu (1998). One reason for this observation is probably the feasibility of measuring the variable of accessibility to public transit through spatial analysis, even though few studies have defined what they mean by *high-quality* public transit. Studies such as Wabe (1967), Daniels (1972, 1981), and Hanssen (1995) brought up the issues of the number of transfers between public transit modes and of crowded public transit as hindrances to its use.

On the other hand, access to the road network, the quality of the roads, the traffic flow on the roads surrounding the work locations, and the average travel time by car before and after the relocation are variables that require further evaluation in the future studies.

In the aggregate, most of the research (17 of 23 studies) concluded that relocation is associated with a significant modal shift—from 15% to 75%—from public and active transport to car use. This finding is not surprising, as most cases involved relocations from the CBD to a suburb. However, it can be concluded that, despite the considerable differences between the North American, European, Asian, and Australian contexts and among various occupation categories, individuals tend to behave similarly when facing a change in the location of their work. In other words, adaptation to geographical change is associated with private transport use. One important concern is that the extent to which this trend would apply solely to workplace relocations is still questionable. Changes in car ownership and its use for commuting trips may be caused by a range of other changes occurring in a household, such as the addition of adults of driving age (J. Dargay & Hanly, 2007; Scheiner, Chatterjee, & Heinen, 2016). Therefore, it is highly advised that more studies like (Sprumont & Viti, 2017), which evaluated the consequences of coincidence of events, be produced in the future.

Finally, studies support the notion that the relocation of jobs can produce significant changes in transportation demand (number of trips, mode choice, trip length) at the enterprise level and in the area of the new location (Aarhus, 2000). Therefore, workplace localization strategies should consider optimal accessibility to transport services and activity opportunities at both the local and regional scales, based on the type of job to be relocated (e.g., employees' income level, socio-professional situations, working hours, etc.). Furthermore, employment relocation strategies need to take into consideration all the different objective and subjective factors that influence the adaptation of short- and long-term decisions, such as commute-mode switching and residential relocation decisions. If these factors converge with strategic policies attempting to integrate land use and transportation, this can help reduce the substantial reliance on private vehicles for commuting journeys, and thus mitigate the negative impacts on the built environment and on individuals' health. Although the studied publications focused mainly on the travel-related impacts of relocation, some proposed, be it explicitly or implicitly, policy implications and effective measures that can be adopted to incentivize sustainable transportation and encourage less

dependency on private automobiles. Table 3.3 provides a list of these measures. For instance, charging parking fees at workplace is recommended by most of the studies, although only Sprumont and Viti (2017) indicated that this strategy was adopted in the new workplace and was indeed promising, resulting in a slight decrease in car-based commutes. Studies such as Aguiléra et al. (2009), which were carried out longitudinally, highlighted that efficient public transport service can increase its rate of use over the years. To this end, it is suggested that job organizations, in collaboration with urban and transportation authorities, implement as much of these measures as possible to maximize their positive impacts.

3.5.1. Strengths and limitations of this review

This review evaluated the extent to which the existing research has progressed towards clarifying the transportation impacts of involuntary workplace relocation. It can be argued that searching through six electronic databases means most relevant research is included in this systematic review. As there always remains a possibility of missing relevant studies due to poor indexing, we checked the reference lists of all included papers to overcome this problem.

Additionally, the inclusion of a whole range of studies from various countries around the world gives a comparative inclusivity to this review, which enabled us to make fair evaluations across the whole range of potential changes that take place following the relocation of a workplace.

This study focused solely on transportation changes associated with involuntary workplace relocation. A comparative study between voluntary and involuntary workplace relocation could reveal valuable insights into the complexity of mobility decisions during different life transitions. Additionally, workplace-related changes in commuting behavior may occur as a result of a change in an existing urban context, such as the opening of a new railway station adjacent to an employment location. For instance, Brockman and Fox (2011) and Wen, Orr, Bindon, and Rissel (2005) evaluated the effectiveness of transportation interventions at workplaces and studied how employees' commuting behavior was subsequently affected.

3.5.2. Strengths and limitations of the available evidence

Although the land-use and transportation characteristics of workplaces greatly influence commuting choices, other factors, such as the commuters' place of residence, and socioeconomic

and psychological characteristics, also play significant roles in characterizing commuting patterns. However, the quality of the existing empirical studies is not very high, as they fail to include all factors simultaneously and do not control for correlations between them. In addition, information about the statistical significance of the results was often lacking. Most of the studies did not analyze the relationship between the relocation and socioeconomic characteristics of the studied population, e.g., car ownership, number of household members who work outside the home, or dependent children needing a school drop off / pick up, etc.

Almost none of the studies discussed the changes and choices of respondents with respect to the concept of utility maximization. This concept, also referred to as the microeconomic approach, follows the assumption that travelers make a rational choice among discrete alternatives to minimize travel time and costs, and maximize their utility (Shen et al., 2009). It is, however, important that utility not be only about minimizing time and cost (quantity), but also maximizing satisfaction and well-being (quality), even at the expense of a higher travel cost. Utility in the latter sense receives less attention in the relevant literature. For instance, some people may maximize their level of satisfaction by spending quality hours in the car with family members while fulfilling daily errands on the way to and from work. In fact, these individuals have accepted the monetary costs associated with car use (fuel, parking, maintenance, insurance, etc.) as they have other priorities when making decisions on their daily travel. Others may want to maintain a sense of security by not changing their place of residence (for those with no economic constraints) and to retain psychological bonds with their present home, even after an increase in commuting distance, time, and cost following a workplace relocation. To this end, it is highly suggested that aspects of these concepts be investigated in more detail in future travel behavior studies.

Additionally, few studies considered the role of transportation and land-use characteristics at employees' home locations. The choice of a transport mode is highly dependent on the way the residence and workplace are connected. Those papers that evaluated the commuting impacts of residential location only included the impact of home–work distance and took notice of neither the transportation possibilities and constraints, nor the presence of activity opportunities close to the workers' place of residence.

Only two studies were concerned with temporal alterations resulting from workplace relocation. Bell (1991) indicated that relocation resulted in a half-hour earlier departure in the morning. A case study from Norway also found some seasonal variation in the distribution of modes (Meland, 2007). It is, however, essential to predict temporal changes as they may result in a misalignment between public transit timelines and office hours. In addition, anticipating such changes can help employers provide facilities to moderate employees' travel demands.

Finally, in most cases, methodological approaches are limited to cross-sectional data sets and, thus, neglect the temporal and longitudinal dimensions of decision-making. Studies did not look at the short-term versus long-term influences of relocation and workers' adaptation process. Some studies examined commuting behaviors a few months after the relocation while others analyzed the impacts over a two-decade period.

3.6. Unanswered Questions and Future Research

The relocation of a workplace, as a major life event, is associated with adaptations of long- and short-term mobility decisions, such as residential relocation or mobility tool ownership. Current theoretical models of the mobility impact of major life events often evaluate the decision-making and adaptation processes after the occurrence of the event. However, as these events are often anticipated in advance, particularly in the case of forced job relocations, it is suggested that studies focus more on the period between anticipation, i.e., when the move is announced by the employer, and the occurrence of the event. This period is a vulnerable stage, in which habits are weakened and attentiveness to alternatives is higher; thus, it has important implications for planning policies aimed at changing travel behaviors towards green transportation.

In addition to changing their place of residence, people may also change educational establishments or their children's school. The chain of relocations spurred by the first relocation, i.e., the workplace, can influence commuting behavior on a wider level. Few, if any, such studies, evaluating the macro effects, have been undertaken so far. Additionally, research in this area is dominated by the use of quantitative research methods; however, qualitative approaches can provide in-depth insight into the experiences and processes of changing commuting behavior after a workplace relocation. As part of a qualitative analysis, it is suggested that future empirical studies not only include psychological factors, such as habits, preferences, and attitudinal characteristics

of employees and their households, in survey questionnaires but also conduct face-to-face interviews to ask people for the reasons for any change (or lack of change) in their travel-related decisions.

Finally, habit, as a key element in the social psychology of behavior that affects individual decision-making needs to be evaluated and considered in studies that concern changes in travel behavior. Habits are helpful for explaining the extent to which changes occur or do not occur. For instance, an identical change in commuting distance for two different individuals may result in different travel mode switching decisions, based on the level of habit strength. It is, however, important to note that the level of habit strength cannot easily be measured or used in the quantitative analysis of large samples. The reason for this is that methods such as the 12-question Self-Report Habit Index (SRHI), particularly when used before and after an event, require respondents to have a vivid memory of their habit, its automaticity, and frequency. Such complexity can pose methodological issues and lead to unreliable responses. A group of transportation scholars (Aarts, Verplanken, & Knippenberg, 1998; Klöckner, 2004) suggests that habits can explain major variations in travel mode selection behavior. If habits take control of travel decisions (e.g., daily commute), the impacts of social factors and norms on moderating travel behavior decreases. Furthermore, the rationale behind continuing habits is often to be more efficient, controlled, and target oriented, which is more attractive than having to constantly make new decisions (Schönfelder & Axhausen, 2010).

Previous theoretical models (e.g., Klöckner, 2004; Verplanken & Roy, 2016) that portrayed the influence of important life events on different levels of habit formation (habitualization), often focused on this process only after the life event has occurred. Additionally, these models did not distinguish between voluntary and involuntary events, or between those that are anticipated a long time in advance and expected only a short time before the occurrence of the event. On the other hand, individuals with different habit strengths are likely to behave differently in the face of changing circumstances and short- or long-term adaptation phases. Therefore, it is essential to measure habit strength when evaluating the impact of a major life event, such as an involuntary workplace relocation, on the daily commute.

Future analyses of the same type of life event and its influence on commuting behavior can refine and extend these results in various ways. First, it would be useful to explore various ways of segmenting the target population. For instance, the variables potentially explaining changes in travel habits after a relocation may be weighted differently depending on occupational category or household composition. Another basis for segmentation is the individual's status as regards habit strength, flexibility, and level of reactivity to change and specifically to such life events. It can be hypothesized that adaptation to change may be realized differently, as some people may go beyond moderate changes by moving their place of residence, while others may adjust their ideals to fit reality.

Table 3.1 Characteristics of included studies and overview of the results
Studied variables: BE: Built Environment (Spatial); T: Transportation; AT: Attitudinal; SE: Socioeconomic; PT: Public Transport

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	Car to PT	Underlying factors
Workplace relocations from CBD to a suburb or subcenter								
Wabe (1967) London, 1964 N: 600 Response rate: 57.2	One survey questionnaire two years after the move	PT-based commute: Men: 85% Women: 93% Car-based commute: Men: 8.4% Women: 6%	PT-based commute: Men: 11% Women: 37% Car-based commute: Men: 75% Women: 50% Commute distance decreased Travel time almost halved	More favorable work trip after the move	Gender, car ownership	✓		• Increased distance to PT at the new workplace • Crowded traveling conditions on PT in central downtown
Daniels (1972) United Kingdom A sample of decentralized offices throughout the country (63 offices) N: 7143 Response rate: 61%	One survey questionnaire and general interview from the employees and at managerial level after the move	Greater London railway used by majority of participants	Average PT use decreased (except for two companies which had good accessibility to rail and bus) Number of cars per household largely increased	-	Occupation, income, car ownership	✓		• Inadequate PT to cope with peak-hour demand • Complete absence of PT services in some parts • The necessity of transfer between modes • Misalignment between PT timetables and office hours
Daniels (1981) N: 7760 Response rate: 47%	Follow up survey of Daniels, 1972	See Daniels, 1972	PT was continually used at a low level (more stably used in Greater London) and private transport increased to 6%	-	Car ownership increased	✓		• Increased share of private transport was a product of the secular trend in car ownership
Cervero & Landis (1992) San Francisco Bay Area, 1987-89 N: 320 Response rate: 60%	One survey questionnaire after the move	Three firms in central city Drive alone: 22.8% Shared ride: 16.9% Mass transit: 58.1 Travel time: 50.2 m	Three different suburban locations Drive alone: 74.9% Shared ride: 21.5% Mass transit: 2.8 Travel time: 36.6m Average commute distance remained unchanged Threefold increase in VMT and 30% increase in travel speed	-	Age, gender, annual occupation, income, number of vehicles, ethnicity	✓		• Urbanites became reverse commuters and experienced the worst access while those who moved their home out of the city got better access • Ethnic groups preferred to stay in CBD

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	Car to PT	Underlying factors
Fernandez (1994) Milwaukee, United States, 1991 Response rate: 82.2%	Face-to-face interview six to nine months before the move; GIS used for home–work distance after the move	High accessibility to PT	Decreased commute distance Low accessibility to PT	-	Age, gender, income, car ownership, race	✓		• Minorities prefer not to relocate their home after suburbanization of their work • Relocation had a disproportionate negative impact on minority males and on white and black women in terms of commuting distance, travel time, and time value – it deteriorated job accessibility for minority groups
Cervero and Wu (1998) San Francisco Bay Area, 1980 and 1990 22 employment centers	Comparison of statistical data available for journey-to-work of 1980 and 1990	Accessibility to PT	Lower density and diversity Commuting distance and time increased 7% increase in drive alone	-	-	✓		• Substantial increase in the share of commuting via drive-alone automobiles and average commute VMT per employee
Aarhus (2000a) Oslo, Norway Three different companies N:6500; N:370; N:80	Interviews with representatives of the companies; review of the relevant planning documents	High accessibility to PT	Significant increase in the share of car-based commutes although companies were still situated within walking distance of PT	-	-	✓		• Increased access to the main road system and free parking
Parolin et al. (2001) Australia Three different companies N:400 Response rate: 51.5% N:150 Response rate: 83% N:66 Response rate: 81%	One survey questionnaire after the move	High accessibility to PT and major retail and commercial activity opportunities	50% reduction in the use of PT and 16% increase in the share of car-based commutes	Satisfaction level	Gender, car ownership, residential relocation decisions	✓		• Increased trip disutility and increased inaccessibility to the new work sites • Infrequent, late, and crowded bus services • Absence of activity opportunities near work • 40% residential move and intention to move • Females participated in activities more than males

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	Car to PT	Underlying factors
Waygood et al. (2007) Kyoto, Japan N: 1000 students and faculty members Response rate: 68.1%	One survey questionnaire nine months after the move	University campus located in high density, mixed land use, surrounded by both affordable and high-end housing Liveable and easily accessible by foot or cycling, great accessibility to variety of services	Low-density, separated land use, close to a residential area financially inaccessible to most commuters Nonmotorized- and PT-based commutes decreased	Personal preferences, commutes in different weather conditions were controlled for	Gender, commute cost, car ownership Occupational position and household composition	✓		• Presence of an arterial and a wide, two-lane road close to the new campus • Increased minimum home–work distance and distance to services • A significant decrease in number of buses served the campus • Absence of two train lines within a 15-minute walk of the new campus • Vehicle ownership significantly positively related to resistance to mode shift • Land use and topography substantially influence mode shift • People living alone were more flexible to move or change modes than those with cohabitants
Workplace relocations from Suburb or subcenter to CBD								
Van Wee and Van Der Hoorns (2002) Netherlands	Two surveys (6 months before and 4.5 years after the move)	-	Commuting distance increased for most of the employees 23% residential relocation (a small number moved towards the new workplace)	-	Income, age, household size		✓	• Easily accessible by PT and very little provision for parking • Total km of commuting journeys (all travel modes) increased more in short-term than long-term equilibrium situation
Meland (2007) Trondheim, Norway, 2000 N: 444 Average response rate: 47%	Two survey questionnaires before and two after the move (based on a one-week travel diary)	Unlimited parking facilities for all employees Bus services only to and from the city center	43% reduction in car use 23% increase in public transport use Walking and cycling for commute almost doubled in total	-	married/cohabitating participants with kids aged 11 or below tended to have a lower degree of change than the average		✓	• Easy access to the entire PT system including the surrounding municipalities • Free parking for only 20% of employees and the number of parking spaces close to the offices decreased. However, parking was paid by the employer for 30% of workers • Out-of-office duties positively related to car use

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	Car to PT	Underlying factors
Workplace relocations associated with insignificant changes in land use and transportation								
Bell (1991) Melbourne, Australia, 1987 N: 1700 Response rate: 64%	Two survey questionnaires (five months before and ten months after the move) based a one-day travel diary	Accessible to train, bus, tram, company car, and by walking Free car parking for 38% of the employees	Commute distance decreased for majority of employees Bus, tram, and train within the walking distance (400 m) of the site	-	Age, gender, occupation, household size, employment details, car and driver's license ownership	✓		• Reduced accessibility to PT and free parking spaces for almost 100% of the employees • Reduction in activities during the day such as leisure and social activities and an increase in activities en route home from work such as taking the children to school • 15% residential relocation (directly and indirectly related to the job relocation) • Car and driver's license ownership increased
Hanssen (1995) Oslo, Norway, 1991 N: 1200 Response rate: 64%	Two survey questionnaires based a one-day travel diary (one month before and 10 months after the move)	Free car parking for 6% of the employees PT use: 61% Car use: 25% PT commuters' home location served by the radial subway system connected them to the work location without any transfer	PT use: 46% Car use: 41% Inner city residents switched from active modes to car Many regional bus routes, railway, and a ferry served the site.The train was within a five-minute walking distance of the building Average travel time remained almost the same	Perception	-	✓		• Free parking for 45% of the employees • 20% increase in PT commuters having to make transfers (their travel time increased by 7 min) • Business journeys during working hours significantly decreased • Onerous journeys by PT after the move

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	Car to PT	Underlying factors
Sim et al. (2001) Singapore (1998) N: 1797 households composed of employers and employees	One door-to-door survey	Accessibility to Mass Rapid Transit (MRT), a large bus interchange and an extensive network of expressways and arterial roads	Planned regional center with land use and transportation efficiently integrated, high-density and mixed use Efficient transport system: the area is well connected to MRT and served by many bus lines, which link the regional center to the CBD and other parts of the island at a fair price PT use: 78% Car use: 5%	-	Occupation categories: clerical, managerial, professional, executive, etc.		✓	• In Singapore, the vast majority (78%) of employees commute by PT • Car commuters were those who lived outside the planned region • Many respondents (mostly clerical job holders) stated unwillingness to continue working in the new location. The chief reason (61.5%) was the longer commuting distance they experienced after relocation
Aarhus (2000b) Oslo, Norway N: 1900	See Aarhus, 2000a	See Aarhus, 2000a	Public transit accessibility and quality remained unchanged	-	-		✓	• Decreased accessibility to car parking
Aguilera et al. (2009) Paris, France A representative sample – A 20-year period of workplace relocation and travel behavior	National Census data (1982 & 1999) and two one-day travel surveys (1983 & 2001)	High accessibility to PT	Low accessibility to PT for outer suburbs and relatively high accessibility for inner subcenters Average home to work distance increased Reverse commuting increased as a result of job suburbanization Commuting on foot and by two-wheeled vehicles significantly increased (1–4%)	-	Socio-professional status: e.g., executive, intermediate and clerical workers and laborers	✓	✓	• The average number of commute journeys diminished as a result of the increase in the average home to work distance • Car use decreased surprisingly for commuting journeys, especially for executives who had more car accessibility, and were replaced by public transit because of the concentration of employment in a zone served by subway and rapid transit systems • Car use increased for laborers whose new workplaces were more dispersed and less well connected to the PT network
Loo and Chow (2011) Hong Kong, 2002 Airport relocation	One travel characteristics survey four years after the move	Accessibility to extensive PT network	Average commuting distance decreased for the residents of the new-growth and rural areas, and increased for urban-core residents	-	-	✓		• Following the airport relocation, new developments took place close to the airport, facilitating shorter commuting for airport employees; however, car commuting increased

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	PT to car	Underlying factors
Burke et al. (2011) Brisbane, Australia	Comparison between the existing transportation model with that of the year 2031, which was proposed as the planning horizon	-	-	-	-		✓	• Strongly planned and guided employment decentralization may not be deleterious to public transit use if jobs are clustered tightly into key suburban activity centers, if transit links are more elaborate and interconnected, and if necessary, cross-suburban bus links are provided
Vale (2013) Lisbon, Portugal N: 1016 Response rate: 42.9%	A self-completion questionnaire before and after the move; binary and multinomial logit model	High accessibility to PT	Mixed-use transit-oriented center in the inner suburbs Commute distance increased 11% increase in car use Commuting time only changed slightly Number of active (-4%) and public transport (12%) users considerably decreased	-	-	✓		• Travel mode inertia and use of faster transport means in order to maintain commuting time within an acceptable limit • The availability of free parking mitigated the impact of land use characteristics and high access to PT
Sprumont et al. (2014) Luxemburg city, Luxemburg, 2012 N: 397 Response rate: 36.4%	Multinomial logit model	High accessibility to PT	A new developing area at the city fringe and the country border Accessibility to PT High monthly parking cost	-	Country of residence	✓		• Lack of mixed land use and increased commuting distance were the main reasons for a shift from PT to car commuting • PT subsidy and high monthly parking cost did not stimulate workers to quit car commuting
Walker et al. (2015) United Kingdom Response rate: 45%	Three survey questionnaires (19 months before, and 1 and 4 months after the move)	The town situated within the outer-London commuter belt, with railway line within 25-min. walking distance of the company	Another town situated within the outer-London commuter belt with railway line within 7-min. walking distance of the company The main change after the relocation was from car, walking, and cycling to train Train use increased by 37% while car use dropped by 33%	EAI: Environmental Attitudes Inventory Self-Report Habit Index (SRHI)	Age, gender, number of children, home location, occupational role within the company		✓	• Increase in train use was partly related to the reduced walking time between the new office and the rail station • The impact of land-use characteristics was found to be stronger than internal cognitions or sociodemographic traits

Study and dataset	Methodology	BE & T	BE & T	AT	SE	Commute mode shift		
		Before-the-move	After-the-move			PT to car	PT to car	Underlying factors
Yang et al. (2017) China General response rate: 52% Individual questions' response rate: 91 – 100%	Survey questionnaire, Discrete choice model, Descriptive statistics, Multinomial regression model	Central city Car use: 28% Pt use: 50% Bike: 10% Walk: 11%	New town at the urban fringe (30 km away), linked to the central city by arterial roads and one metro line Car use increased by 17% PT use decreased by 15% Bike use decreased by 5% Walking increased by 3%	-	Age, gender, income, having kids, home location, car ownership, professional status	✓		• Mode choices are strongly influenced by travel time and residential location • Considerable differences between anticipated (sustainable) and actual (car) modal shift after job relocation, particularly for those who continued living in central city
Sprumont and Viti (2017)	A two-week travel-activity diary both before and after the move GIS data collection, descriptive statistics, standard deviational ellipses (SDE) combined with cluster analysis	Few kilometers away from the city center	Average commute distance increased Significant distance between the new and the old workplace (20 km) Commute time increased	-	Age, gender, profession, having a child, home location, coincidence of other life events were investigated (e.g., home relocation, childbirth, buying a car)	✓		• Slight increase in car-based commute as a result of parking costs imposed on the new workplace, as well as a car-sharing system, an online car-pooling platform, and inter-campus shuttle • 19% of respondents relocated their home but not necessarily because of job relocation • One person relocated homes although commute distance decreased (living and working in the same place was undesirable for the person) • After workplace relocation people significantly modified their activity space and kept it close to home

Table 3.2 Factors affecting commuting mode-switching decisions directly or indirectly

Factors affecting commuting behavior during the process of workplace relocation		Type of impact		Impact on shift to PT mode		Included but not explicitly explained	Total
		direct	indirect	+	-		
Transportation Infrastructure at workplace		✓		(Aarhus, 2000; Cervero & Landis, 1992; Cervero & Wu, 1998; Meland, 2007; Parolin et al., 2001; Wabe, 1967; Waygood et al., 2007; Yang et al., 2017)			8
Parking at workplace		✓			(Aarhus, 2000; Bell, 1991; Hanssen, 1995; Meland, 2007; Sprumont & Viti, 2017; Sprumont et al., 2014; Vale, 2013)	(Burke et al., 2011; Yang et al., 2017)	9
Residential location	**Home–work distance**	✓			(Cervero & Landis, 1992; Cervero & Wu, 1998; Daniels, 1972, 1981; Sprumont & Viti, 2017; Wabe, 1967; Yang et al., 2017)		7
	Diversity		✓	(Waygood et al., 2007)			1
Car and driver's license ownership		✓			(Bell, 1991; Wabe, 1967)	(Daniels, 1972)	3
Trip chain and presence of activity opportunities		✓			(Bell, 1991; Hanssen, 1995; Meland, 2007; Parolin et al., 2001; Sprumont & Viti, 2017; Waygood et al., 2007)		6
Relocation to planned site		✓		(Burke et al., 2011; Sim et al., 2001)			2
Socioeconomic characteristics		✓	✓	(Meland, 2007; Waygood et al., 2007)	(Daniels, 1972; Fernandez, 1994; Parolin et al., 2001)	(Cervero & Landis, 1992; Sprumont & Viti, 2017; Vale, 2013; Yang et al., 2017)	9
Travel-related habits, perceptions and attitudes towards quality of PT		✓	✓	(Parolin et al., 2001; Wabe, 1967; Walker et al., 2015; Waygood et al., 2007)			4
Anticipation of the move		✓	✓			(Sprumont et al., 2014; Wabe, 1967; Walker et al., 2015; Yang et al., 2017)	4

(+) If presence or change of factor results in mode shift from private to (PT) public transport

(-) If presence or change of factor results in mode shift from public to private transport

(0) If presence or change of factor has no impact on mode switching decision

Table 3.3 Effective measures to encourage sustainable transportation and less private-automobile dependency

Transport mode	Land use	Strategic planning	Measures	Authors
Car	-	-	Charging **parking fees** (to be set quite high according to the income of the employees in order to have any effect) and road user charges to car users	(Aarhus, 2000; Cervero & Landis, 1992; Daniels, 1981; Hanssen, 1995; Meland, 2007; Sprumont et al., 2014; Vale, 2013)
			Decreasing access to **parking** by imposing binding maximum limits on parking coverage relative to office area or number of employees	(Cervero & Landis, 1992)
			Collecting **impact fees** from the developers of the suburban workplaces in case of sprawling office parks that encourage **auto dependence**	(Cervero & Landis, 1992)
			Imposing regulations such as mandatory trip reduction targets, e.g., regulation XV in Southern California encouraged increasing average **vehicle occupancy** levels to as high as 1.75	
			Car sharing (carpooling), reserved parking for carpoolers, guarantee for return journey	(Sprumont et al., 2014)
		✓	Simultaneously applying **economic restrictions** on car ownership and use	(Sim et al., 2001)
Public transportation	-	-	Maintaining viable urban centers to preserve the ridership base of **mass transport** and ridesharing modes	(Cervero & Wu, 1998)
			Channeling work locations with high-capacity and efficient **public transport** interchanges such as rail and underground stations in the suburbs	(Aguiléra et al., 2009; Daniels, 1972; Sim et al., 2001; Vale, 2013)
			Subsidizing **public transit** season ticket, developing shuttle service	(Sprumont et al., 2014; Walker et al., 2015)
Active transportation	-	-	For those who commute by **bicycle or on foot**: Washing and changing facilities, providing rain clothes, subsidizing bike sharing system, providing a personalized cycling commuting map, bike repair station, etc.	(Sprumont et al., 2014)
-	✓	-	Defining the **accessibility** needs of a workplace to public transport or car transport based on the transportation needs of the people (employees and clients) or goods	(Aarhus, 2000)
	✓	-	Developing **integrated transport / land use** planning where jobs are clustered into key activity centers at transit nodes	(Burke et al., 2011; Loo & Chow, 2011; Parolin et al., 2001; Sim et al., 2001; Vale, 2013)
-	-	✓	Having the possibility of teleworking and flexible work time to improve employees' professional/private life balance	(Sprumont et al., 2014)
		✓	Preparing employees for travel-related challenges and encouraging sustainable travel before the relocation.	(Walker et al., 2015)

4. Chapter Four: An Investigation of Commute Mode Choice and Satisfaction Following a Workplace Relocation

4.1. Overview of the Chapter

Numerous studies have found that travel mode choice and travel satisfaction are interdependent. However, a comprehensive overview of these determinants is lacking as it is still unclear why the use of various travel modes specially for home-work journeys results in different levels of travel satisfaction. Moreover, few studies have analyzed the extent to which commute satisfaction varies for different profiles of individuals considering socio-demographic characteristics for employees of a relocated workplace. This study aims to present an overarching overview of objective factors affecting commute mode choice and satisfaction (including socio-demographic and certain travel and built environment characteristics) and to assess the extent to which they influence travel satisfaction independent of mode choice. In this study, with a retrospective quantitative approach, 1977 employees who have experienced an involuntary relocation of their workplace have been examined vis-à-vis their travel mode choices and satisfaction. Results indicate that first, the relocation of the workplace was associated with increased public transit use and travel satisfaction; second, while commute mode choice is a function of various determinants which vary according to the mode, travel satisfaction is most significantly influenced by spatio-temporal factors, i.e., perceived travel time and geographical accessibility; third, contrary to the results from previous literature where bus users are often the least satisfied travellers, in our sample drivers experienced more commute dissatisfaction.

Keywords: Travel behavior; commute mode choice; travel satisfaction; quantitative; workplace relocation; sustainable modes; Montreal

4.2. Introduction

With the aim of increasing the quality of life of individuals and their subjective well-being (SWB), recent transportation researchers have started focusing on evaluating travel satisfaction. Travel satisfaction is an outcome of experienced feelings during travels and/or positive or negative evaluation of these travels (De Vos, 2019b). A traveller's feelings and evaluations often result from 1) the trip characteristics and the service offered (e.g., cost, duration, punctuality, etc.) and 2) the person's perception of and reaction to the service which varies based on his/her socio-demographic, psychological characteristics such as attitudes, values, habits, predispositions, and lifecycle variables. These factors are together called external and internal factors that influence travel satisfaction (St-Louis et al., 2014). As transportation professionals and policy makers seek to stimulate the widespread use of low-carbon transport modes – also called sustainable modes, i.e., walking, bicycling and public transit - it is important to acquire a deeper understanding of travel satisfaction as well as factors that result in travel dissatisfaction and its implications for travel behavior.

With the development of measurement methods a growing number of recent studies have examined the link between travel-related determinants (e.g., travel mode, time, cost, socio-demographics, etc.) and overall trip satisfaction (Abou-Zeid, Witter, Bierlaire, Kaufmann, & Ben-Akiva, 2012; J. Cao, 2013; Ettema, Friman, Gärling, Olsson, & Fujii, 2012; Mokhtarian, Papon, Goulard, & Diana, 2015; Olsson, Gärling, Ettema, Friman, & Fujii, 2013; Páez & Whalen, 2010; St-Louis et al., 2014; Susilo & Cats, 2014). While the majority of the studies have found travel mode choice to be one of the most influential determinants of travel satisfaction, there are numerous factors that affect travel satisfaction independently of the chosen travel mode, the focus of this paper. The present study targets the commute behavior and satisfaction of more than 10,000 employees of the new McGill University Health Center (MUHC) in Montreal, Canada. It compares modal choice and commute satisfaction across five different transport modes (car, bus, metro, train, active transport (walking and bicycle)), and examines how determinants of modal choice and commute satisfaction vary across modes. This

objective is based on the assumption that first, modal choice and commute satisfaction are mutually linked and second, the relevant influential determinants can influence travel satisfaction both directly and through modal choice. Using binomial regression models, we develop five models of modal choice and two models of trip satisfaction (satisfied versus not satisfied) that include the same independent variables (built environment, trip characteristics, and personal characteristics). This paper begins with a review of existing literature on the concept of travel satisfaction and creates new insights into the links between modal choice, other non-mode travel-related determinants, and travel satisfaction. Next, the study presents the data collection and analytical methods, while the findings are presented in Section 4.5. Finally, the paper concludes with a discussion of the implications for research and policy (Section 4.6).

4.3. Literature Review

Travel behavior literature shows that travel mode choice often results from a compound decision-making process that is influenced by three major categories of factors: (1) accessibility – i.e., the range of mobility alternatives which may vary according to spatial characteristics (e.g., density, diversity, design, etc.) and journey characteristics (e.g., travel time, cost, weather condition, etc.), and that relates to the socio-demographic characteristics of the decision-maker and that of their household members; (2) competence – i.e., skills and abilities of the decision-maker individual with which he/she makes use of access (e.g., driving license, knowledge relating to the regulations of the movement, etc.); (3) socio-psychological evaluation of the access and competences by the decision-maker, which is shaped by needs and preferences, and relates to attitudes, values and habits (De Vos, 2018, 2019b; De Witte et al., 2013; Kaufmann et al., 2004; Zarabi & Lord, 2019). It is suggested that in addition to travel

mode choice, trip satisfaction is also influenced by the mentioned factors both through mode choice and independently[9].

The research framework adopted in this study is illustrated in Figure 4.1. This conceptual model indicates that travel satisfaction and modal choice are not only mutually related (i.e., they influence each other) but are also influenced by three main groups of determinants[10]. While modal choice is directly influenced by the determinants of mode choice (e.g., cost, reliability, etc.), residential location (e.g., distance to public transit), and travel satisfaction, these determinants influence travel satisfaction both directly and through modal choice. For example, travel time or reliability are both mode choice and travel satisfaction determinants which can influence travel satisfaction directly or through modal choice. The proximity of a residential location to grocery stores can facilitate fulfilling shopping needs on the way from work to home which in turn results in commute satisfaction (irrespective of modal choice).

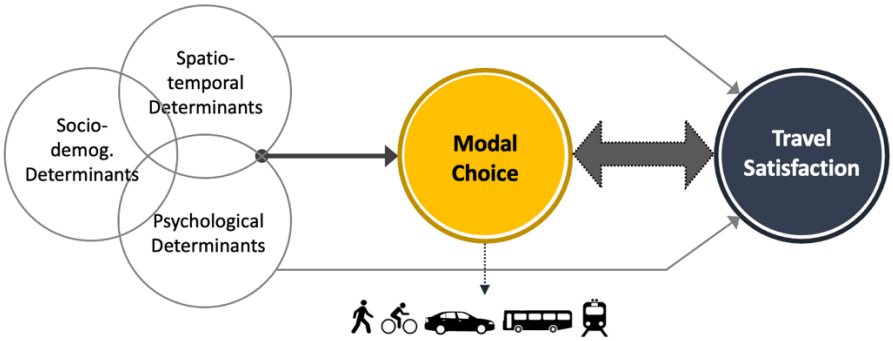


Figure 4.1 Conceptual framework. Direct and indirect link of modal choice and travel satisfaction – Source: Author.

Majority of studies that have focused on travel satisfaction have especially looked at the influences of chosen travel mode. These studies generally acknowledge the highest level of satisfaction for active travelers, and the lowest for public transport users (e.g. Chng, White,

[9] While the first two factors are measured and discussed in the present Chapter, the socio-psychological elements of travel behavior are assessed in the next Chapter.

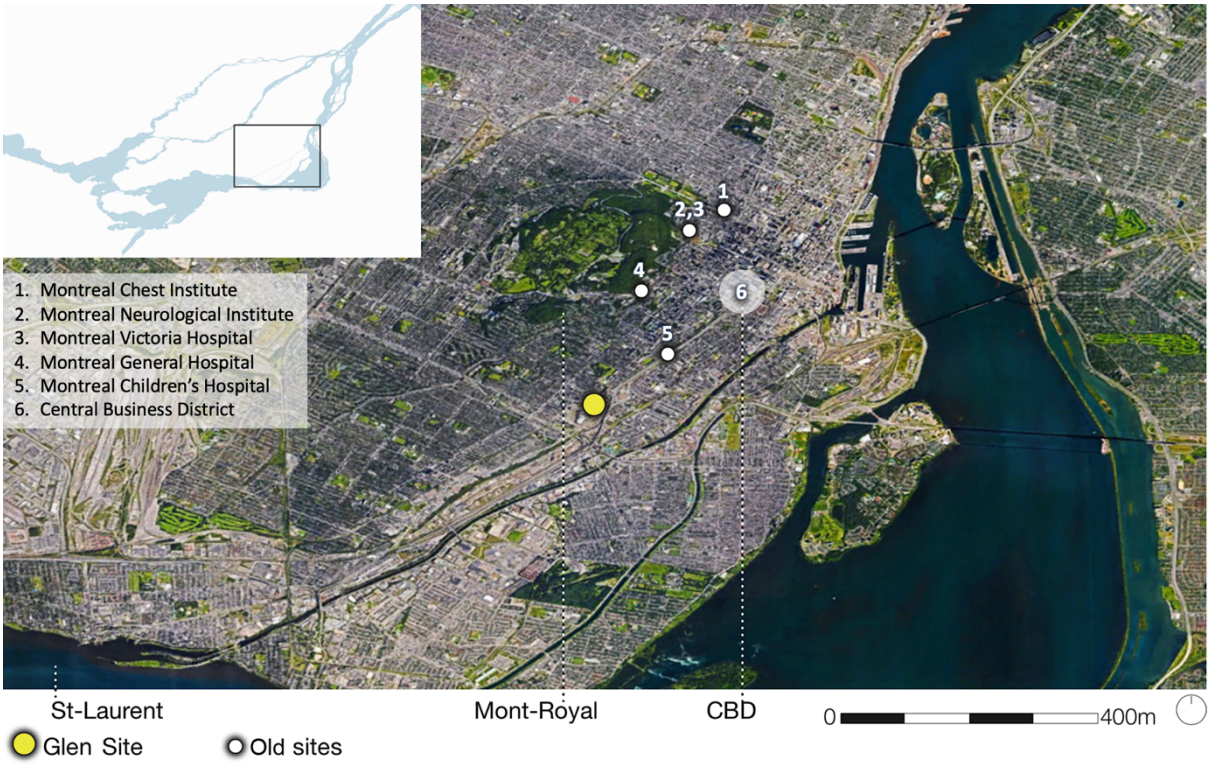
[10] Factors that determine modal choice are called modal choice determinants (see, e.g. De Witte et al., 2013). The terms determinant, variable, and factor might be therefore used interchangeably in this study.

Abraham, & Skippon, 2016; De Vos, Mokhtarian, Schwanen, Van Acker, & Witlox, 2016; Morris & Guerra, 2015b; St-Louis et al., 2014; Ye & Titheridge, 2017; Z. Zhu, Li, Chen, Liu, & Zeng, 2019). In addition to travel mode, studies have examined the relationship between travel satisfaction and other trip characteristics including trip duration, indicating that shorter trip duration and travel satisfaction are often positively related (e.g. Gerber, El-Geneidy, Manaugh, & Lord, 2020; Higgins, Sweet, & Kanaroglou, 2018; Hilbrecht, Smale, & Mock, 2014; Morris & Guerra, 2015a; J. Zhu & Fan, 2018), distance that can both positively or negatively influence travel satisfaction based on trip purpose (De Vos et al., 2016; Handy & Thigpen, 2019; Mokhtarian et al., 2015; Schneider & Willman, 2019), performance of activities during trips that can increase travel satisfaction (e.g. Ettema et al., 2012; Lyons, Jain, & Holley, 2007; Tang, Zhen, Cao, & Mokhtarian, 2018; Zarabi, Manaugh, & Lord, 2019), and travelling in companionship or alone, portraying that traveling alone results in more levels of dissatisfaction (e.g. De Vos, 2019a; Lancée, Veenhoven, & Burger, 2017; J. Zhu & Fan, 2018). Socio-demographic characteristics of travelers are also among objective determinants of travel satisfaction that are evaluated by fewer studies. While some characteristics, such as age (De Vos et al., 2016; Jason & Dick, 2014; Ye & Titheridge, 2017) and general health condition (Ye & Titheridge, 2017) are shown to have direct effects on travel satisfaction, others such as income and education influence travel satisfaction through mode choice. In the present study, these characteristics plus gender, occupation category, and country of birth will also be looked at to acquire a better understanding of mode choice and travel satisfaction. According to a recent literature review taking into account the travel influences of involuntary workplace relocations (Zarabi & Lord, 2019), out of 22 papers, only one discussed travel satisfaction in addition to mode choice after a relocation of the University of Luxembourg (Sprumont, Astegiano, & Viti, 2017). It is therefore important to fill a gap in the measurement of commuting satisfaction of individuals who have experienced an involuntary workplace relocation by incorporating a combination of objective determinants of modal choice and travel satisfaction.

4.4. Methodology

4.4.1. Context of the project

The relocation of the McGill University Health Center (MUHC) took place between March and June 2015. More than 10,000 employees were progressively relocated from five hospitals in the Montreal downtown core to the new site, called the Glen site, located southwest of downtown a few kilometers (~5km) from the old sites (Figure 4.2). The new complex is situated next to a bus terminus, a subway station and a regional rail station and not far from a motorway interchange serving two highways structured at the national level. Therefore, the site is quite accessible by both private and public transport and improves overall access by these modes compared with the old hospital locations; however, the ongoing constructions on the existing road networks impose variable traffic conditions, especially during peak hours (CIMA+, 2011; Dessau-Soprin, 2005) which results in walking and bicycling to be comparatively less conveniently doable at the new site. The MUHC complex includes multi-level parking with electric vehicle charging facilities for the employees and ample underground paid parking for patients and visitors.



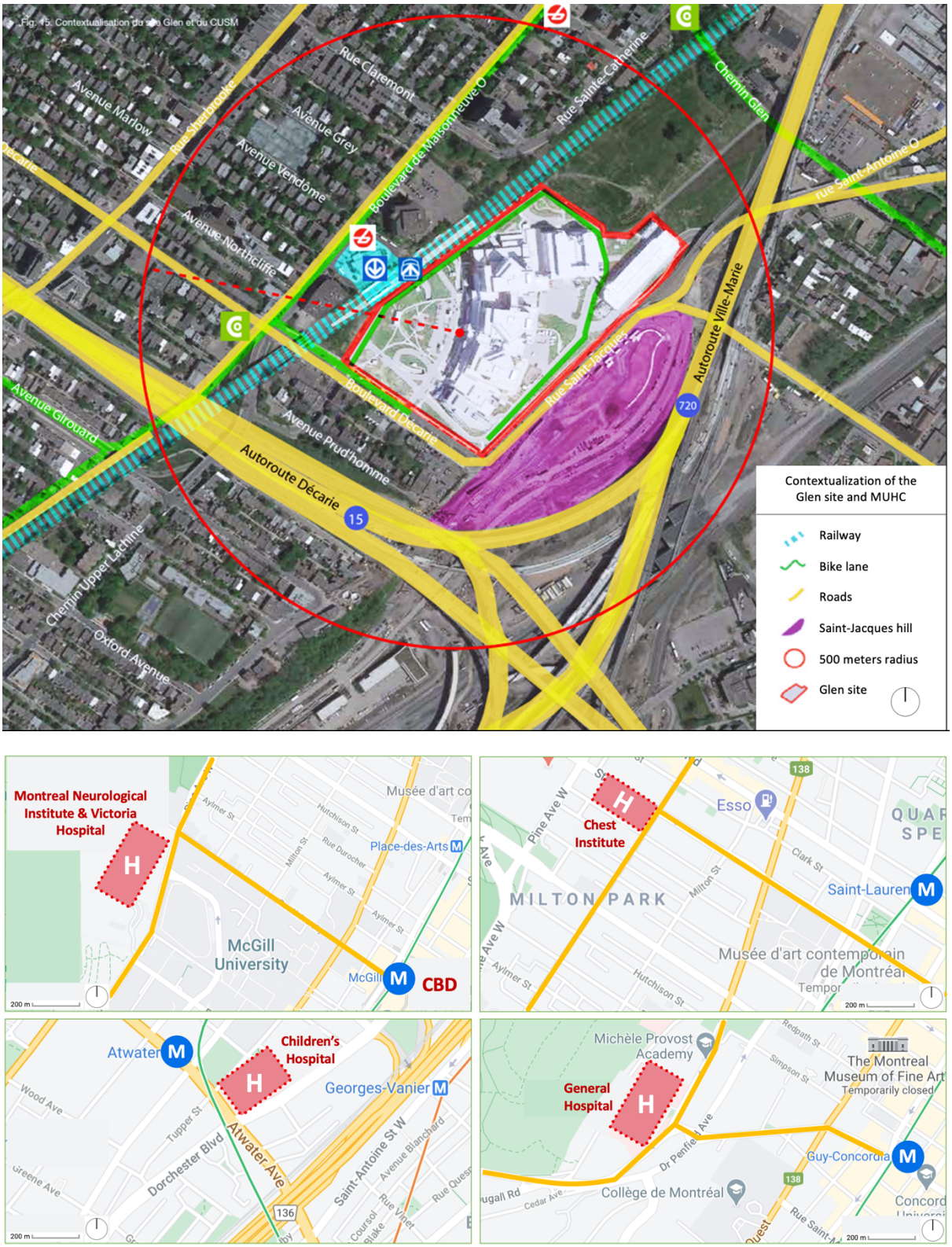


Figure 4.2 The location of the old and new hospitals of the McGill University Health Center (MUHC), Montreal, QC, Canada – Source: Dévaud (2018) (Top), Perrin (2018) (Middle), Author (Bottom)

4.4.2. Online questionnaire

An original quantitative retrospective approach was conducted in May 2018 to collect and analyze data on before- and after-the-move travel-related decisions made by the employees and their households. The self-completion retrospective questionnaire was designed as a web form with LimeSurvey© with the help of the MUHC human resources service and published online in both the English and French languages. In order to encourage employees to participate, the survey was announced through digital ads illustrated on screens inside the complex as well as the internal website of the MUHC. One week prior to the launch of the online survey, the employees received an email regarding an upcoming email about the survey, in which the aim and scope of the corresponding research was explained. The employees were asked to check their inbox on the determined date. On 14 May 2018, (approximately 7500)[11] employees of the MUHC were invited via email to participate in the online survey questionnaire. The email included a link that directed them to a web-based questionnaire, which typically took about 20 to 45 minutes to complete. The project was announced as a study on "understanding the consequences of relocation of the MUHC to the Glen site"[12]. The invitation email was sent for the second time after one week as a reminder to those employees who did not have a chance to complete it.

The survey is composed of five separate sections: i) The first section contained questions regarding the main commute mode used (the one in which the respondent spent the most time) during the previous week, with specific working days and shifts (N = 1977), ii) the context and the satisfaction with the work and residential places (old and new homes if changed since 2002 when the MUHC officially announced the relocation) before and after the relocation of the workplace (N = 1372), iii) the possible change of typical daily commute (e.g., mode, time,

[11] Even though the relocation of the MUHC in 2015 affected the commuting habit of more than 10,000 employees, the approximate number of regular occupants working at the Glen site is around 7500. This figure takes into account the fact that a predictable percentage of employees are on long-term illness/maternity leave or on vacation at any given time.

[12] For this survey, ethical approval was granted by the Multi-Faculty Research Ethic Committee at the University of Montreal.

frequency, cost, and parking at work) and trip chain (e.g., kids pick up/drop off, shopping, leisure activity, etc.) before and after the move (N = 1147), iv) travel mode attitudes and routines (N = 1072), and v) the last section concerning the residential and household socio-economic characteristics (N = 1010). Given that 7500 employees received the survey email, response rate varies for each survey sections, between 26 and 14 percent. Relative to the information provided by the MUHC human resources, our sample underrepresents individuals younger than 35 years of age (22.8 percent versus 36.8 percent in the MUHC records) and overrepresents females (78 percent versus 74 percent respectively) among the target population (Gerber et al., 2020). Despite these limitations and inevitable inconsistencies that make our results ungeneralizable to the entire Montreal population, the sample has noteworthy characteristics such as the inclusion of the before- and after-the-move perspectives, higher number of females than males, variety of occupation categories and nationalities, etc. that together provide a unique sample. Among the numerous variables investigated in the survey, the present study focuses on the after-the-move modal choice and travel satisfaction determinants in order to better understand the direct and indirect link between modal choice and travel satisfaction (dependent variables) – as explained in the conceptual framework (Figure 4.1).

4.4.3. Data characteristics

Table 4.1 presents the sample characteristics. In general, the survey captures a variety of population of the employees which is fairly a representative of all MUHC employees. The respondents were relatively equally distributed among four different age groups, and substantially more likely to be female than men, educated (68.4 percent vs. 31.6 percent diploma/college and below), have high annual household income, have at least one child (59.2 percent), and own at least one car (85.4 percent). Eight principal job categories have also been distinguished (recoded according to the nomenclature of the MUHC) among which nurses, therapists, and other technical medical staff were most populated (34.4 percent) similar to the average of all MUHC employees.

Table 4.1 Socio-economic and demographic characteristics of the respondents

Characteristics		Cases N	Cases %
Gender (N = 1022)	Male	225	22
	Female	797	78
Age groups (N = 1014)	<35 years	231	22.8
	35 – 44 years	265	26.1
	45 – 54 years	266	26.2
	55 – 64 years	197	19.4
	>65 years	55	5.4
Education (N = 1020)	College, technical high school and below	57	5.6
	Diploma / Technical	265	26.0
	Undergraduate degree	356	34.9
	Master's degree	195	19.1
	Medical Doctor and Ph.D. degree	91	8.9
	Other	56	5.5
Household annual income (N = 1018)	< 60 000 $	144	14.1
	60 000 $ to 99 999 $	242	23.8
	100 000 $ to 139 999 $	177	17.4
	140 000 $ to 179 999 $	114	11.2
	180 000 $ to 300 000 $	103	10.1
	>300 000 $	46	4.5
	Prefer not to answer	192	18.9
Occupation category (N = 1383)	Nursing, Respiratory therapists and perfusionists	476	34.4
	Service, Para technical and volunteer staff	95	6.9
	Administrative technician	103	7.4
	Administrative professional	154	11.1
	Health, social and laboratory technicians	163	11.8
	Health and social professional	98	7.1
	Doctors, specialists, managers, residents	172	12.4
	Professionals and researchers	122	8.8
Region of birth (N = 1014)	Africa and Asia	84	8.3
	Canada	787	77.6
	Europe	84	8.3
	United States	59	5.8
Number of cars in household at time of the survey (N = 1075)	0	157	14.6
	1	447	41.6
	2 cars and more	471	43.8
Number of driver's license owners in household (N = 1016)	0	32	3.1
	1	280	27.6
	2	492	48.4
	>2	212	20.9
Number of children in household (N = 848)	0	346	40.8
	1	161	19
	2	247	29.1
	>2	94	11.1

4.5. Findings

4.5.1. Modal choice and change at the Glen site

In order to analyze the choice of commute mode at the new workplace, we operationalized commuting mode as a dichotomous variable, comparing individuals who used any mode (among bus, metro, train, car, active transport) with others. Therefore, we developed a binary logistic regression model (Table 4.5) to examine the effect of various determinants on the probability of choosing each mode. Table 4.2 provides a summary of commute mode choice at the Glen site. Figure 4.3 also provides a comparison between before- and after-the-move modal choice by the employees as well as travel patterns during the weekdays versus weekends. The relatively high share of low-carbon transport use for commute (nearly 20% increase) suggests a good match between the demand and supply of public transit, especially the existence of the train and various frequent bus lines at the Glen site. Car use being almost doubled during the weekends also points out to the irregular schedules of public transit as well as commuters' higher tendency to drive during non-peak hour conditions.

Table 4.2 Main commute mode used after the relocation of the MUHC, at the Glen site (N = 1419)

		Frequency	Percent	Percent
Car	Car Solo	377	26.6	30.6
	Carpool-share-taxi	57	4.0	
Public Transit	Bus	131	9.2	59.3
	Metro	468	33.0	
	Train	242	17.1	
Active Transport	Bicycle	80	5.6	10.1
	Walk	64	4.5	
	Total	1419	100.0	100.0

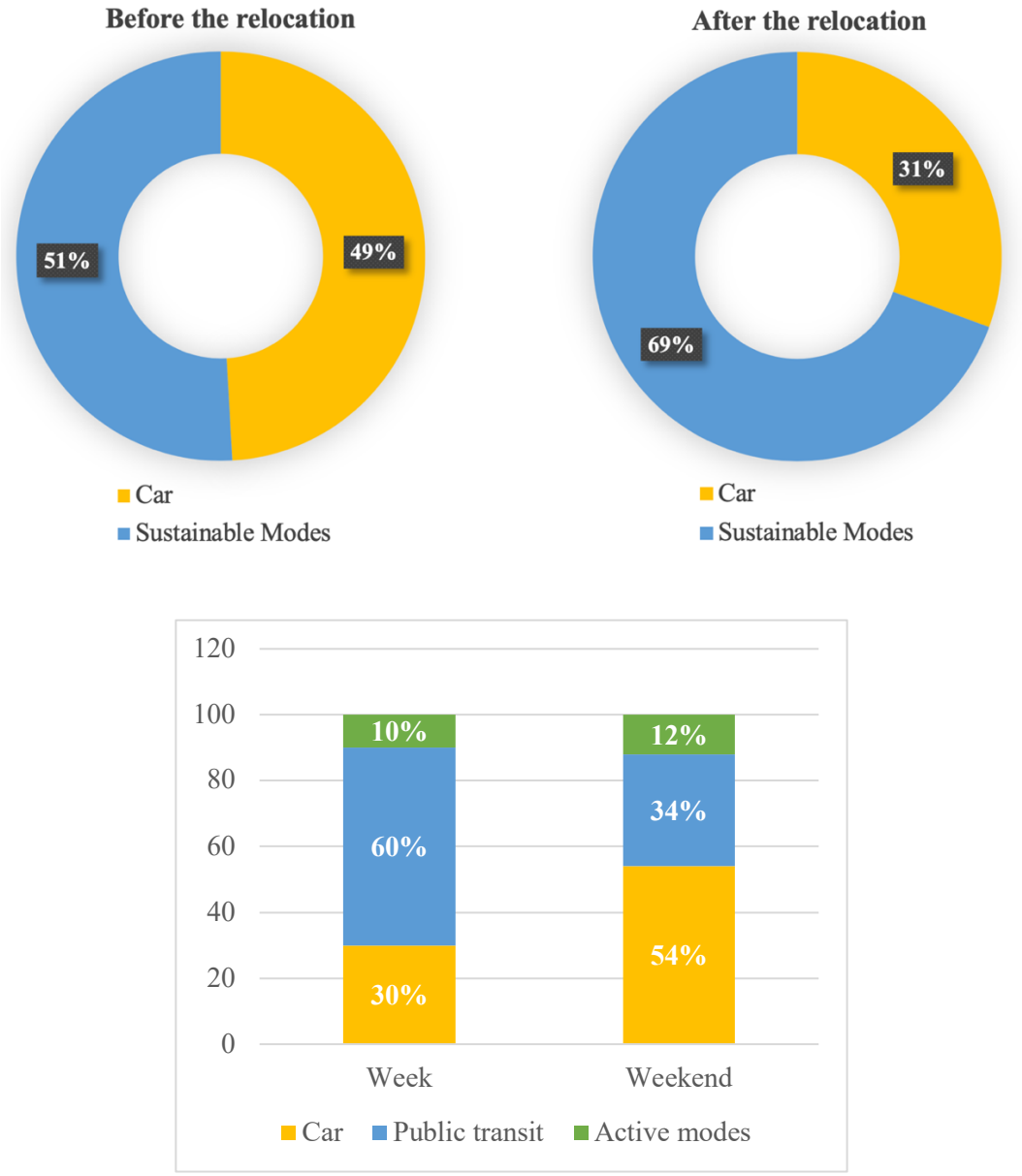


Figure 4.3 Top: Modal choice comparison between before (left, N = 1071) and after (right, N = 1419) the relocation; Bottom: Modal choice comparison between weekdays and weekend at the Glen site.

Table 4.3 provides the modal change status following the relocation of the MUHC. Results indicate that almost 60 percent of the respondents did not actually change their commute mode after the move, whether by public transport and active modes (23.8 percent) or car use (34.9 percent). Of those who did change their travel mode, nearly 30 percent switched from one sustainable, i.e., low-carbon transport mode (public transport and/or active modes) to another sustainable mode (e.g., bicycle to bus) (15.2 percent), followed by car (and other possible modes) to sustainable (14.2 percent). Only 11.9 percent of the respondents changed from sustainable modes to car, which is the

least desired behavior change in the context of sustainable behavior change. These individuals might have had certain restrictions (e.g., familial, financial, geographical, etc.) or some resistance to changing their travel habits (Bamberg, 2006; Zarabi, Manaugh, et al., 2019). Overall, the results corroborate with that of the previous studies in that workplace relocations that take place within the city and are associated with access to better transportation services positively influence mode shifts from private to public and active transports (Meland, 2007; Van Wee & Van Der Hoorn, 2002; Zarabi & Lord, 2019).

Table 4.3 Modal Change Status Following the Relocation of the MUHC (N = 1071)

Modal shift status	Before-the-move	After-the-move	Percent
No change	Sustainable modes	Sustainable modes	23.8
	Car	Car	34.9
Change	Car (and others)	Sustainable modes	14.2
	Sustainable modes	**Car (and others)**	**11.9**
	Sustainable modes	Other sustainable modes	15.2
	Total		100.0

4.5.2. The satisfied commuters at the Glen site

Figure 4.4 presents commute satisfaction by mode before and after the relocation. Regarding the satisfaction level, the most satisfied commuters are, in order: Pedestrians (97.2 percent), cyclists (85.7 percent) (overall active modes were 90.6 percent), train users (81.5 percent), metro users (76.1 percent), bus users (69.6 percent), and drivers (54.3 percent). This result is consistent with previous studies that found active transport users and train commuters are, on average, relatively more satisfied with their travel. When aggregating the modes into three categories (public transport, active modes, car), active transport users showed to be six times and public transport users three times more satisfied than car commuters. However, this might be resulted from the sampling criterion resulted from the survey's question: "What was the mode of transportation in which you spent the most time while commuting to the Glen site?". For instance, rail passengers who take a 10-minute metro to arrive at the train station and then travel for 20 minutes are in fact multimodal commuters who are misrepresented as train users, hence, it is not clear to which mode their overall commute satisfaction is actually related. Contrary to the majority of previous studies (e.g. De Vos et al., 2016; Smith, 2013; St-Louis et

al., 2014; Ye & Titheridge, 2017), the lowest level of satisfaction was observed among drivers rather than bus users. Bus passengers were 3.6 times more satisfied than drivers. This observation can be partially attributed to first, the relatively insufficient accessibility for car users due to road closures, constructions, and heavy peak-hour congestion in the motorway interchanges around the Glen site and second, the existence of various frequent bus lines next to the Glen.

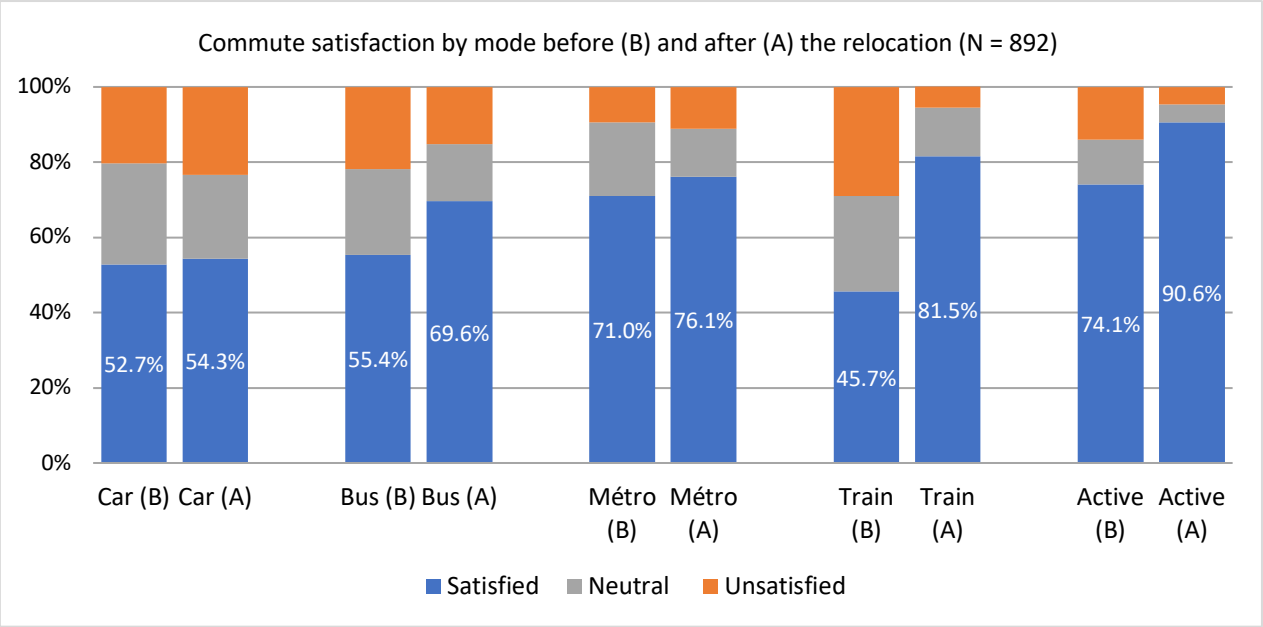


Figure 4.4 Commute satisfaction by mode before and after the relocation

The variable of commute satisfaction was examined based on a two-part question capturing the before- and after-the-move satisfaction level: "Overall, how satisfied were/are you with your typical daily commute… before the relocation to the Glen site/after the relocation to the Glen site?" The answer options were presented as a five-point Likert scale, from 'very satisfied' to 'very unsatisfied'. Generally, commute satisfaction has increased between the two considered periods (Table 4.4). Nearly 70% of the respondents are currently satisfied or very satisfied with their commute to work compared to 59.3% before the relocation, testifying to a general improvement of the travel conditions, or at least of its perception. Relative to the before-the-move situation, rail passengers showed the highest level of increase in commute satisfaction (from 45.7 percent to 81.5 percent). Compared to the location of the former hospitals which

were not served by a nearby regional train station, the Glen site provided this facility accessible via an underground tunnel that took employees to their offices within around five minutes. Therefore, the high satisfaction increase for the rail passengers is not surprising. The travel satisfaction increase was followed by active mode users (from 74.1 percent to 90.6 percent), bus users (from 55.4 percent to 69.6 percent), metro users (from 71 percent to 76.1 percent), and drivers (52.7 percent to 54.3 percent).

Table 4.4 Overall commute satisfaction before and after the relocation of the MUHC (N = 1140)

	Before	After
(Very or) Satisfied	59.3	68.9
Neutral	23.2	15.9
(Very or) Unsatisfied	17.5	15.2
Total	100	100

4.5.3. Exploring the determinants of modal choice and travel satisfaction

The regression results are summarized in Tables 4.5 and 4.6. In order to analyze the determinants of commute mode choice, we developed a binary logistic regression model to compare individuals who used any mode (among bus, metro, train, car, active transport) with others. Then we assessed the influence of various factors on the probability of selecting each mode. A variable is considered significant if the Sig. is less than 0.1 (the lower the Sig., the more significant the variable). Exp(B) (i.e., exponentiation of the B coefficient) also explains the probability of choosing a mode for each variable (the higher the Exp(B), the more likely the mode is chosen for that particular variable). Although the explanatory power of the model (R^2(Nagelkerke)) is not very high the significance of the variables and the magnitude of their effects across modes and satisfaction are worth examining. Socio-demographic and trip characteristics are examined to explore tendencies related to personal and external factors influencing modal choice and trip satisfaction. These models allow for ceteris paribus ("all other things being equal") analysis. This means the studied independent variables are considered in isolation from one another when the causal relation between one independent and the dependent variable is observed, hence, the probabilities are explicit on the variable effect. Findings are discussed below.

Table 4.5 Commute mode determinants across five categories of modes (N = 559)

Commute mode	Car		Bus		Metro		Train		Active modes	
	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)	Sig.	Exp(B)
Socio-economic characteristics										
Gender (Female)	.328	1.424	.310	1.969	.069	1.897	.479	.714	.000	.156
Age group (Ref: [55 to 64])										
20 to 34	.724	1.166	.167	2.537	.931	1.037	.033	.253	.032	.188
35 to 44	.161	1.742	.091	2.984	.338	.675	.055	.340	.071	.277
45 to 54	.338	1.452	.643	1.357	.792	.899	.420	.656	.032	.205
65 and higher	.622	1.447	.998	.000	.733	.784	.950	.924	.049	.124
Region of Origin (Ref: Canada)										
Africa and Asia	.065	.384	.319	.481	.036	2.357	.680	.765	.462	.481
Europe	.037	.314	.463	.424	.280	1.583	.589	.648	.728	.789
United States	1.000	1.000	.969	.971	.670	1.237	.047	.108	.314	2.145
Education (Ref: Undergraduate degree)										
College, technical high school, and below	.386	1.303	.758	.847	,968	,983	.848	.894	.465	1.985
Diploma/technical	.159	.631	.935	.957	,960	1,020	.692	1.244	.996	.000
Master's degree	.760	.915	.395	.623	,497	1,258	.185	1.812	.708	1.251
Medical doctors and Ph.D. degree	.506	1.331	.236	.234	,261	,544	.963	.965	.120	3.211
Occupation category (Ref: Doctors, specialists, managers, residents)										
Nursing, Respiratory therapists and Perfusionists	.859	1.074	.070	.220	.702	.824	.172	3.129	.560	.637
Service. Para-technical and volunteer staff	.211	2.157	.578	.515	.150	.167	.027	13.501	.998	.000
Administrative technician	.554	1.342	.910	.895	.114	2.718	.234	4.259	.125	.125
Administration professionals	.646	.810	.917	.916	.754	1.197	.010	9.407	.136	.199
Health, social and laboratory technicians	.204	.544	.796	.801	.392	1.614	.002	17.791	.269	.293
Health and social professionals	.084	.439	.059	.137	.477	1.478	.000	24.835	.456	.563
Professional and researchers	.163	.468	.408	.447	.727	1.217	.001	20.503	.678	.739
Income (Ref: 100 000 to 139 000 $)										
< 60 000 $	.371	.672	.697	.755	.768	.877	.843	1.148	.379	.433
60 000 $ to 99 999 $	.407	1.282	.120	2.373	.348	.719	.546	1.344	.196	.400
140 000 $ to 179 999 $	.984	1.007	.916	1.083	.352	.657	.106	2.369	.862	1.143
180 000 $ to 300 000 $	.689	.864	.801	1.257	.309	.551	.001	8.121	.929	.929
>300 000 $	.682	1.218	.998	.000	.829	1.162	.998	.000	.262	.344
Prefer not to answer	.344	1.338	.530	1.447	.036	.429	.992	1.005	.766	1.223
Household characteristic										
Having at least one child under 13 years in 2018	.821	1.057	.246	.584	.210	.682	.090	1.987	.369	1.639
Number of cars per household (Ref: Owning one car)										
Zero	.019	.529	.883	.929	.020	1.951	.039	.271	.286	1.717
Two and more	.000	2.264	.543	.779	.000	.302	.086	1.975	.006	.183
Trip characteristic										
Proportion of travel time by PT to Car <1	.143	.617	.006	.050	.002	2.489	.012	.155	.215	.486
Working elsewhere than the Glen	.430	.815	.573	.745	.684	.879	.061	.428	.789	.870
Traveling during the week vs. weekends	.121	1.635	.096	4.060	.008	4.807	.019	16.985	.147	6.078
Previous workplace (Ref: Victoria Hospital)										
Montreal General Hospital	.939	1.022	.402	.615	.905	1.042	.552	.726	.134	.335
Montreal Children's Hospital	.527	.866	.809	1.113	.546	.839	.768	1.128	.219	1.856
Others	.025	.392	.247	1.985	.418	.692	.024	3.353	.860	1.157
Perceived travel time in minutes (Ref: From 31 to 40)										
From 0 to 20	.318	1.354	.240	.430	.079	.513	.446	.631	.159	2.334
From 21 to 30	.419	1.261	.178	.399	.607	.829	.394	.614	.644	.720
From 41 to 50	.161	.625	.303	1.887	.099	.469	.965	1.026	.123	.158
51 and higher	.000	.246	.089	2.625	.584	1.244	.559	1.335	.105	.135
Residential location (Ref: Montreal Island)										
Laval (North)	.001	3.989	.057	.200	.038	.330	.178	2.047	.997	.000
Longueuil Agglomeration (South-East)	.012	2.638	.072	2.437	.144	.526	.003	.072	.778	1.311
North of Laval (North ring)	.451	.601	.998	.000	.016	6.602	.317	.386	.998	.000
South of Longueuil Agglomeration (South ring)	.142	1.828	.250	.510	.008	.203	.119	2.175	.997	.000
Outside of the Greater Montreal	.006	7.163	.998	.000	.998	.000	.042	5.703	.999	.000
R^2 of Nagelkerke	.260		.344		.369		.473		.460	

(The correlation is significant at the 0.01 level.)

Table 4.6 Determinants of commute satisfaction (n=559)

Commute satisfaction	Satisfied		Neutral/Unsatisfied
	Sig.	Exp(B)	Exp(B)
Socio-economic characteristics			
Gender (Female)	.635	1.183	.845
Age group (Ref: [55 to 64])			
20 to 34	.375	.682	1.465
35 to 44	.690	.851	1.175
45 to 54	.874	1.064	.940
65 and higher	.048	.237	4.211
Region of Origin (Ref: Canada)			
Africa and Asia	.520	1.336	.748
Europe	.070	2.627	.381
United States	.556	1.333	.750
Education (Ref: Undergraduate degree)			
College, technical high school, and below	.322	1.490	.671
Diploma/technical	.809	1.092	.915
Master's degree	.045	2.051	.488
Medical doctors and Ph.D. degree	.795	1.166	.858
Occupation category (Ref: Doctors, specialists, managers, residents)			
Nursing, Respiratory therapists and Perfusionists	.441	1.857	.538
Service. Para-technical and volunteer staff	.259	1.771	.565
Administrative technician	.550	1.466	.682
Administration professionals	.158	2.234	.448
Health, social and laboratory technicians	.498	1.464	.683
Health and social professionals	.062	3.158	.317
Professional and researchers	.363	1.785	.560
Income (Ref: 100 000 to 139 000 $)			
< 60 000 $	.824	1.115	.897
60 000 $ to 99 999 $	.617	1.190	.840
140 000 $ to 179 999 $	.900	1.054	.949
180 000 $ to 300 000 $	.783	1.153	.867
>300 000 $	.024	6.649	.150
Prefer not to answer	.935	.969	1.032
Household characteristic			
Having at least one child under 13 years in 2018	.455	.805	1.242
Number of cars per household (Ref: Owning one car)			
Zero	.519	1.232	.811
Two and more	.015	.486	2.059
Trip characteristic			
Proportion of travel time by PT to Car <1	.015	.428	2.335
Working elsewhere than the Glen	.533	.821	1.218
Traveling during the week vs. weekends	.762	1.132	.883
Previous workplace (Ref: Victoria Hospital)			
Montreal General Hospital	.256	1.559	.642
Montreal Children's Hospital	.048	.575	1.740
Others	.539	.765	1.307
Perceived travel time in minutes (Ref: From 31 to 40)			
From 0 to 20	.000	17.028	.059
From 21 to 30	.000	4.468	.224
From 41 to 50	.706	1.156	.865
51 and higher	.018	.434	2.305
Residential location (Ref: Montreal Island)			
Laval (North)	.754	1.136	.880
Longueuil Agglomeration (South-East)	.902	.954	1.048
North of Laval (North ring)	.963	1.034	.968
South of Longueuil Agglomeration (South ring)	.985	1.008	.992
Outside of the Greater Montreal	.625	1.433	.698
Residential ownership status (Ref: Owner)			
Tenant	.983	.992	1.008
Residential type (Ref: Single family house)			
Plex	.296	1.552	.644
Apartment	.296	.636	1.573
Commute mode (Ref: Car)			
Bus	.003	3.619	.276
Metro	.000	5.638	.177
Train	.000	10.137	.099
Active modes	.094	2.658	.376
R^2 of Nagelkerke	.427		

(The correlation is significant at the 0.01 level.)

The effects of socio-demographics on modal choice and travel satisfaction

Compared to men who tend to use active transport around six times more for commuting, women were more likely (1.6 times) to use bus and metro. Gender and travel satisfaction were not significantly related in our sample while some previous studies have shown significant associations between these variables (Handy & Thigpen, 2019; St-Louis et al., 2014); for examples, males using bus and metro being much more satisfied than their female counterparts possibly due to the lower sense of security from crime perceived or experienced by women (Loukaitou-Sideris & Fink, 2009). In our model, gender is an example of the determinants that influence modal choice but not satisfaction; although men are more likely to walk or cycle to work and active commuters are shown to be the highly satisfied (discussed in more detail later), being a man cannot necessarily explain commute satisfaction among active travellers.

Regarding the age group, our reference category – i.e., those aged between 55 and 64 – were more likely (~5 times) to commute by active modes and be relatively more satisfied (~2 times) compared to others. Those who were above 65 years were significantly less likely to use public transit compared to other age groups and this choice was significantly related to the elderly's travel dissatisfaction. For younger generations, however, the effect of age on travel dissatisfaction was relatively less significant, the younger the less satisfied with their commute irrespective of mode choice. These findings suggest that while travel dissatisfaction for seniors is an outcome of mode choice, for younger participants the existence of other factors is likely to mediate the trip satisfaction level. A positive association between age and travel satisfaction has been reported in previous studies (De Vos et al., 2016; Jason & Dick, 2014; Ye & Titheridge, 2017).

In terms of the region of birth, respondents were categorized into four main groups: born in Africa and Asia, Europe, United States (U.S.), and Canada. Results included a higher tendency (~3 times) to drive for commute among participants who were born in Canada compared to Africans, Asians, and Europeans, and a higher tendency (~2 times) to walk or cycle among U.S. residents compared to Canadians. While the former trend is not very surprising – as the

commonly held belief suggests that Europeans are more likely to use public and active modes of travel – the latter was indeed unprecedented – as Americans, on average, are more auto reliant in their daily life (St-Louis et al., 2014). While the likelihood of being a rail passenger and born in Canada was highest among other regions of origin, others were more likely to use metro for commute. With regards to satisfaction level, Canadians were found to be the least satisfied among others.

Among the eight identified occupation categories, 'Doctors, Specialists, Managers, and Residents', the reference category, were found to use car and active transport more than others. Comparatively, all other employees were significantly around three times more likely to commute by public transit, especially train (twenty-four to ten times higher use of train), than other modes. Job category and travel satisfaction were not as significantly related as expected, albeit the models indicated positive associations between train use and commute satisfaction. Among all 'Health and Social Professionals' who allocated the highest share of train passengers to themselves showed to be three times more satisfied than the reference group. This indicates that while mode choice is a determining factor affecting commute satisfaction for the mentioned job category, it is obviously not the only determinant.

With respect to education, contradictory results were found compared to the previous studies' (e.g. Ye & Titheridge, 2017). Considering the type of occupation in our target population (i.e., mainly health professionals with irregular working shifts such as evening, night, and weekends) these contradictions are not very surprising. Except for few (e.g. St-Louis et al., 2014), the majority of previous studies, however, have not discussed the job category of their sample but only their level of education or job hierarchy (e.g., executive professions versus clerical workers) (e.g. Aguiléra et al., 2009). While Ye and Titheridge (2017) found a positive association between high education level and car use our results indicated that medical doctors and those with a Ph.D. degree were highly more likely (~3 times) to use active transport modes than other modes compared to others. This can be partly related to the fact that residential neighborhoods located within walking distance of the Glen site are relatively expensive (e.g.,

Westmount), hence more affordable for these employees compared to others. A second assumption is the likelihood of a positive association between education levels – especially among those who have a healthcare-related occupation – and having stronger health and environmental concerns. A notable association between education and commute satisfaction was only observed among employees with master's degree. The mere association of education and mode choice compared to education and commute satisfaction can be explained through two hypotheses: while for some individuals the modal choice driven by education level can influence satisfaction (either positively or negatively, like for the Ph.D. owners discussed above), for some others education influences satisfaction through other determinants (e.g., having higher education and more stressful job and vice versa).

Contrary to some older studies, in our sample, the variable of annual income and modal choice did not show to be as significantly related as expected. Only a higher share (~8 times) of train passengers was observed among participants with higher income. Aguiléra et al. (2009) showed that the level of car use for low-income people increased significantly when their travel distance increased after the relocation of their workplace, whereas high-income participants who had greater access to a private automobile switched to public transit as a result of access to sufficient quality public transport. Abad et al. (2020) also demonstrated that after a travel routine disruption (flood event), low-income employees were more likely to adapt their commuting behavior to avoid late arrival at their workplace and to satisfy employer expectations. Regarding trip satisfaction, highest income employees (over 300,000$) at MUHC showed to be six times more satisfied with their commute compared to the reference category – i.e., 100,000$ to 139,000$. Such determinants that influence travel satisfaction much more than modal choice actually affect satisfaction through non-mode specific factors such as home-work distance, travel time, overall job or life satisfaction. As the new MUHC provided various on-site accessibilities to restaurants, gym, etc. all in a brand-new building as well as more advanced technology facilities compared to the old hospitals, a higher workplace attachment and job satisfaction was observed (see, Gerber et al., 2020), which then resulted in a higher commute satisfaction. Other non-mode specific elements that can influence trip satisfaction

and discussed by previous studies include commuter personality, behavior and preferences (Abou-Zeid & Ben-Akiva, 2011; St-Louis et al., 2014; Zarabi, Gerber, & Lord, 2019). Jakobsson Bergstad et al. (2011) discussed the relationship between overall life satisfaction and trip satisfaction. Zarabi, Gerber, et al. (2019) also argued that people attribute different weights to their travel-related attitudes and values, hence, satisfaction in other life domains can make a travel dissatisfaction bearable or even favorable. For instance, for those who give special value to living in a large house (even if it is remote from work), high household income allows them to meet their desires, which then possibly offsets the potential dissatisfaction associated with a long commute distance. In that sense, having high income possibly moderates the subjective assessment of the negative aspects of the commute (e.g., unpunctuality).

Employees coming from households with at least one child under the age of thirteen (at the time of the survey) were found more likely to use train and active modes compared to others. The reason underlying this trend can be explained through various assumptions. For example, the necessity of being chauffeured by car to/from school by one of the parents forces the other parent to walk or cycle to the Glen. It is also possible that some rail passengers who need car to reach the train station drive their children to/from school on their route.

The ownership of two cars or more was significantly associated with the use of car as well as the train for commutes when compared to households with only one car or no car. The positive association between car ownership and train use suggests that these respondents probably live outside of walking distance from a train station and have to drive to the station and transfer modes. This assumption can also partly explain why the ownership of two cars is associated with lower levels of satisfaction. It is, however, important to note that this model does not clearly specify the underlying causes of dissatisfaction. Not surprisingly, those who had no cars in their household were more likely to use metro or active transport relative to others. Finally, neither home ownership status (being an owner versus a tenant) nor residential type (plex, apartment, house) showed any association to modal choice and commute satisfaction.

In sum, the model results indicated quite a difference in socio-demographic traits of employees using different commuting modes. In particular, the car commuters were more likely to be female, born in Canada, among 'doctors, specialists, managers, and residents', and those who had two or more cars in their household. Active travellers were also more likely to be male, between 55 and 64 years old, among the highest educated participants, and not own a car. Satisfied employees were also more likely to have a master's degree, be from Europe, be from among the group of health and social professionals, have higher incomes, and own fewer than two cars.

The effects of travel and geographical characteristics on modal choice and travel satisfaction

There is no doubt that the variable of travel time plays a substantial role in determining modal choice and commuter satisfaction. While generally for all transport modes increased travel time has a negative effect on trip satisfaction, some studies have shown that active mode users are either less negatively affected (Humagain & Singleton, 2020; St-Louis et al., 2014) or even appreciate longer commute times (Páez & Whalen, 2010). In this study, using residential location (center point of the Canadian census tract) we developed a measurement ratio for each participant by dividing travel duration using public transport modes by travel duration using car. The value of the ratio could be equal to, smaller or larger than one. Findings demonstrated that for shorter travel durations by public transit (that can be a combination of bus, metro, and train) than by car the likelihood of bus being one of the chosen modes is less compared to situations where travel duration is longer by public transit than by car. In other words, choosing bus as part of the trip chain can significantly increase travel time possibly due to its non-punctuality and/or the numerous stops on the route when compared to metro or train. Results also indicated a great significance regarding the probability of choosing metro over car and active transport modes for those who live in areas where home-work trip is shorter by metro than private automobile. This observation recalls findings from numbers of previous studies such as Walker et al. (2015), Vale (2013) and Aguiléra et al. (2009) that spatial and physical

infrastructural factors are considerably important in encouraging the use of public transportation. However, the likelihood of these individuals being among satisfied commuters was also very low. This indicates that the choice of metro is unlikely to be mediated by the self-selection process (i.e., public transit commuters self-select to reside in transit-accessible neighborhoods) resulting in commute dissatisfaction. In addition, in some areas living in a metro-favorable neighborhood (i.e., shorter travel time by metro than car in our definition) is associated with higher levels of crowd in metro which may lead to travel dissatisfaction. However, it should be noted that the model does not prove whether having short travel time – although is a metro-commuting stimulator – affects travel satisfaction necessarily through modal choice as the mode choice and satisfaction models are independent. Moreover, the ratio actually measures the relative commute time whereas the actual time might still be perceived long for these individuals.

With regards to the perceived travel time, the questionnaire also asked the respondents to write down the typical length of their daily travel to work. Accordingly, commute durations in minute were categorized into five groups: travel time between 0 and 20, 21 and 30, 31 and 40, 41 and 50, and more than 51 minutes. The regression models indicated that, compared to the reference group (31 to 40 minutes), for longer commute times the likelihood of using bus and metro increases while driving decreases. Drivers were mainly among the reference category with an average commute time between 31 and 40 minutes, a peak hour travel length that is most likely associated with living approximately within the 20 kilometers radios of the Glen site. Surprisingly, there was no significant association between long trips and train use. Not surprisingly, however, active transport use for the shortest commute duration group was significantly higher relative to other trip lengths. With respect to commute satisfaction, results were as expected; the shorter the trip length, the higher the level of satisfaction observed. However, the variable of travel time (or at least the perceived travel time) showed to influence travel satisfaction more independently than through modal choice (Table 4.5) implying that travel duration can influence one's satisfaction much more than the travel mode. In our satisfaction models the highest level of satisfaction was observed among commuters with less

than 30 minutes of travel time and the lowest level for those with more than 50 minutes of travel time. However, for those who had 41 to 50 minutes of commute duration the satisfaction was surprisingly more than the reference category with 31 to 40 minutes of commute length. As the former category were mainly among public transit users and the latter among drivers who experience heavy traffic congestion during peak hours – especially around the Glen site – the observed satisfaction level is less surprising. These results together suggest that travel time is possibly less influential in determining travel satisfaction when convenience is compromised except for trip durations that are beyond the 'acceptable or tolerable' limit (i.e., more than 50 minutes). These findings are in line with the concept of commuting time tolerance that has been previously discussed by Vale (2013); employees who experience an increase in commuting distance after the relocation of their workplace, switched to car-based commute to keep their travel time within an acceptable limit.

Regarding the commuters' residential location, six main categories were defined: Inside the Montreal Island, North but outside of the Island (Laval), Longueuil Agglomeration (South and Southeast but outside of the Island), North of Laval (North ring), South but outside of the Island, and others which include those who live outside of the Greater Montreal. These categorizations were done based on the areas' residential density and the fact that access to the Island from these areas are feasible via metro and train as well as over-the-river bridges (for cars and buses) that together are often overly crowded and bear heavy traffic congestions during the peak hours, hence, result in distinctive commuting patterns from those of the inner-city areas. Results demonstrated significant associations between residing outside of the Montreal Island and the use of private automobile for commute. This association was considerably more significant (~7 times) for those who lived outside of the Greater Montreal pointing to the positive relation between the choice of car and the combination of excessive commute distance and inaccessibility to public transit. Except for Longueuil residents who do not have access to the train and tend to commute to the Glen by bus, the residents of other regions were noticeably more likely to use train for their commute compared to the residents

of the Island who traveled by metro. Travel satisfaction and region of residence were not significantly related.

The previous workplace of the employees was also analyzed in the modal choice and satisfaction models. Those who used to work elsewhere than the three principal hospitals of the MUHC (Montreal General, Children's, and Victoria Hospitals) before the relocation, showed to noticeably choose train (3.3 times more than others) – at the Glen site – for their commute. Those who formerly worked at Victoria Hospital were also found to become more satisfied with their commute compared to others after the relocation. Taking into account that Victoria Hospital was previously situated on top of a hill with relatively difficult accessibility specially during the winter, this observation was not surprising. Considering that previous commute satisfaction can influence current satisfaction level (as satisfaction is a comparative feeling that can be influenced by past experiences (Zhang, 2017), this result is more understandable, in a sense that those with a relatively poor accessibly at their former workplace are presently more satisfied with their commute when compared to employees whose commute experiences are less improved when relocated to the Glen site.

Findings include that commuting during weekdays is significantly associated with public transit use (7 times) – particularly the train (sixteen times) – compared to weekends when people tend to drive their car to commute. Since the train schedules are highly less frequent (and even unavailable in some areas) during the weekends, these results are not unexpected. No significant link was observed regarding the modal choice and travel satisfaction of those employees who worked during the evening or night or elsewhere than the Glen site.

Finally, our satisfaction regression models demonstrated that compared to drivers, the highest level of commute satisfaction was observed among rail passengers (10 times more than car users), followed by metro (5.6 times) and bus users (3.6 times), and active travellers (2.6 times).

To derive respondents' overall commute satisfaction score, in addition to the question "Overall, how satisfied are you with your commute satisfaction after the relocation?", we also looked at

the satisfaction level towards other trip-related variables including accessibility to public transportation, home-work distance, accessibility to paid parking, availability of amenities on Glen site (gym, restaurants, etc.), and proximity to services and amenities offsite (bank, gym, etc.). Results suggested significant positive association between these variables and overall commute satisfaction at the Glen site. Overall, the results confirm our conceptual model (Figure 4.1) in that travel satisfaction and modal choice not only mutually influence each other but are also influenced independently by some determinants (Figure 4.5). For example, travel duration can affect travel satisfaction both through and irrespective of mode choice while gender influences only the modal choice and income influences only the commute satisfaction.

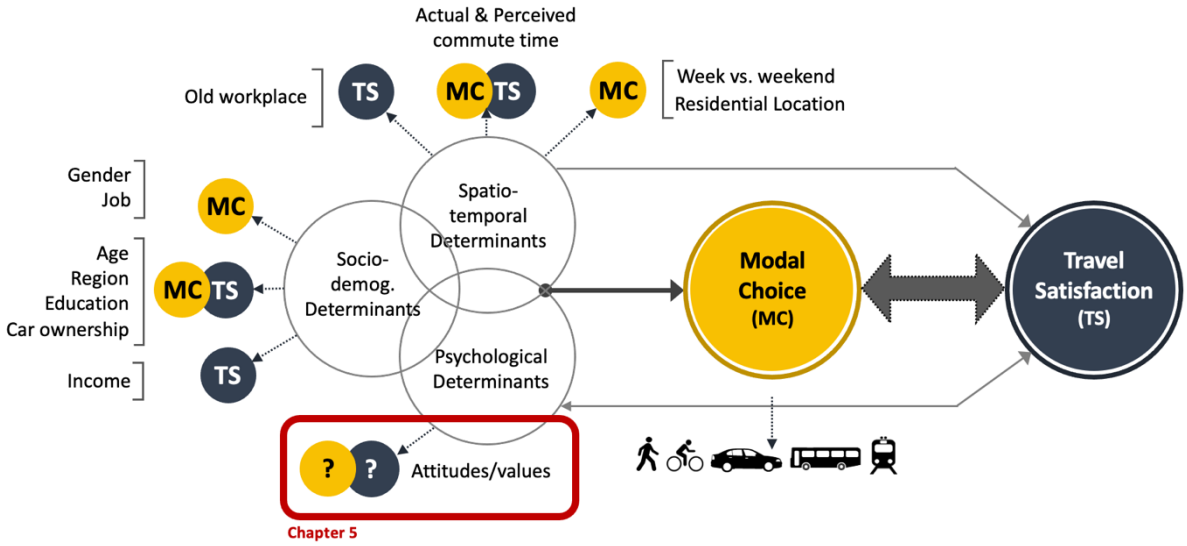


Figure 4.5 Satisfaction-Modal choice interdependencies

In order to understand the rationales underlying modal choice and the causal link to travel satisfaction, examining travel-related psychological characteristics such as attitudes and values is also essential, and qualitative analysis can help us in analyzing this complex mechanism. Chapter 5 explores these relationships using a qualitative approach.

4.6. Discussion and Conclusions

Using quantitative data from the commuting behavior of the MUHC employees we analyzed the objective determinants of modal choice and commute satisfaction including socio-

demographic and certain travel and geographical characteristics including travel time, residential location, type and ownership status, previous workplace, working during the week vs weekends, and working at the Glen site vs at other MUHC-related addresses. Results indicated that travel satisfaction and modal choice not only can mutually influence each other but can also be influenced independently by some determinants. Therefore, despite majority of studies showed that the chosen mode has a significant influence on travel satisfaction, this study suggested that this association can indeed be overestimated. For instance, it is not clear whether the positive effect of having less than 20 minutes travel time on travel satisfaction is the result of having a short travel duration itself, or walking and cycling, i.e., the choice of mode (which may help the release of dopamine that increases feeling of pleasure or bring financial benefits by not having to pay to go to the gym), or merely having positive environmental preservation attitudes towards active modes. Furthermore, the low levels of satisfaction with bus might possibly be a result of an inferior punctuality rather than a (perceived) lack of control (Beirão & Sarsfield Cabral, 2007) as we found rail passengers and metro users to be relatively satisfied in spite of their uncontrollability over the mode. In addition, contrary to the majority of studies car users were found to be less satisfied than bus commuters which according to our results the driver's dissatisfaction with commute might possibly be related to non-mode factors such as commute duration or overall life satisfaction coming from income level or age. This observation can also partly be explained by the existence of extensive road construction and the resulting heavy traffic congestion that was ongoing at the time of the survey in the highways surrounding the MUHC as well as almost all over Montreal agglomeration. In addition, the scarcity of free parking around the Glen site, the relatively high cost of employees' parking, and the existence of various bus lines next to the hospital's main entrance can be among the other reasons for drivers to be less satisfied than bus users. These findings indicate that travel satisfaction differences across modes are not merely caused by the characteristics of the mode itself but are likely to be mediated by commuters' socio-demographic characteristics and/or the exogenous interventions at the geographical context.

Although this study has provided valuable information regarding the link between commuters' mode choice and commute satisfaction, future studies can provide additional insight. Significant attention should be paid to the construction of measures that include travel-related psychological factors such as mode-specific attitudes and preferences. Moreover, it is important to take into account a wider range of travel-related dimensions including spatial, familial and professional factors and examine them by considering the interactions between household members and their needs, abilities and preferences, which can constrain the use of a preferred mode, and thereby affect travel satisfaction. Doing so, insights can be gained on the causes, dimensions and consequences of non-mode travel-related choices such as travel route, trip chain, or residential location. In this regard, more qualitative studies that apply in-depth interviews could also provide valuable information.

Overall, this study highlighted that a strategic relocation of a major workplace – even from downtown (often perceived to be more accessible by public transit than the rest of a city) to a pericentral location – can result in a significant increase in both the use of low-carbon transport modes and commute satisfaction. In fact, the existence of the regional train station in addition to the metro and bus facilities has resulted in a 15 percent increase in switching from car to sustainable modes and a total of around 70 percent non-car commutes by the employees not to mention the travel behavior of the patients and their visitors. The evidence from this study offers three important implications for future sustainable planning practice that attempt to encourage less automobile dependency and more public/active transport use. First, policy makers should pay special attention to the accessibility of workplaces to better transit service than is the current practice, especially in cases of relocation as travel-related decisions are more likely to be changed and guide behavior during such life events. Second, while majority of older studies have concentrated on mobility responses to workplace decentralizations, more studies should pay attention to inner-city major workplace relocations. Finally, the entire household situation and interactions should be evaluated rather than individuals exclusively.

5. Chapter Five: Travel Satisfaction vs. Life Satisfaction: A Weighted Decision-Making Approach

5.1. Overview of the Chapter

Numerous studies have found that travel mode choice is related to mode-specific attitudes as well as travel-related satisfaction. While choosing a travel mode that is congruent with attitudes towards that mode (i.e., consonance) brings about travel satisfaction, travel-related satisfaction can result in the choice of a travel mode which is not necessarily consistent with (all) attitudes (i.e., dissonance). However, few studies have analyzed the extent to which consonance and dissonance affect or are affected by the overall travel-related satisfaction. This paper aims at understanding whether respondents with a positive attitude towards a certain mode will actually use the mode, and whether consonant travelers are more satisfied with their trips and travel-related situations compared to their dissonant counterparts. Additionally, research in this area is dominated by the use of quantitative methods, leading to a lack of understanding of the complexity of subjective factors such as attitudes and values. In this study, with a retrospective mixed method approach, 1,977 (in the quantitative section) and 19 (in the qualitative section) employees who have experienced an involuntary relocation of their workplace have been examined vis-à-vis their travel-related values and attitudes, corresponding choices, and satisfaction. Results from our quantitative analyses surprisingly indicate that the share of dissonant active mode users was relatively high compared to other modes (except bus). Our qualitative analyses also revealed that individuals do not necessarily use the most positively valued travel mode due to lack of accessibility and competences, but also due to having preferences for other travel-related elements such as travel route. Furthermore, travel mode consonance (or dissonance) and travel satisfaction (or dissatisfaction) are not necessarily positively related because (i) individuals attribute different weights to their travel-related attitudes and values, and (ii) satisfaction in other life domains can make a travel dissatisfaction bearable or even favorable.

Keywords: Travel behavior; workplace relocation; attitudes; values; travel satisfaction; life satisfaction; quantitative and qualitative; weighted decision-making; Montreal

5.2. Introduction

Improving the quality of life of individuals and increasing sustainable mobility are two of the principle targets of scholars and policy makers across various disciplines including transportation, geography, economy, sociology, and psychology (De Witte et al., 2013; Zhang, 2017). From a multi-disciplinary point of view, the overall life satisfaction, i.e., a general evaluation of one's life, both affects and is affected by satisfaction in each life domain (e.g., financial, marriage, health, travel, etc.) (Diener, 2009; Schimmack, 2005; Schwanen & Wang, 2014; Zhang, 2017). Recently, a growing awareness of the complex and mutual relationship between mobility satisfaction and life satisfaction has opened the debate on how individuals manage their daily travel-related choices and the extent to which these choices are congruent with sustainable transport policies. In order to take adequate policy measures to increase life satisfaction while encouraging individuals to adopt non-car transport habits, a deeper understanding of their decision-making process is necessary. Some studies have examined this process through the mobility biographies approach—i.e., travel habits are more likely to be changed during life-changing events, thereby low-carbon transport policies are more effective (see, e.g., Lanzendorf, 2003; Müggenburg et al., 2015; Scheiner, 2018). In this context, the important key event of residential relocation has gained much attention in transport research (Gerber, Ma, Klein, Schiebel, & Carpentier-Postel, 2017; Klinger & Lanzendorf, 2016; Zarabi, Manaugh, et al., 2019), while few studies have been devoted to the mobility impacts of workplace relocation, especially one that is involuntary (as in organizational mergers), as is the focus of this paper.

Travel behavior literature shows that modal choice for commuting often results from a compound decision-making process that is influenced by three main categories of factors: (1) accessibility—i.e., the range of mobility alternatives which may vary according to spatial characteristics (e.g., density, diversity, design, etc.) and journey characteristics (e.g., travel

time, cost, weather condition, etc.), and that relates to the socio-demographic characteristics of the decision-maker and that of their household members; (2) competence—i.e., skills and abilities of the decision-maker individual with which they make use of access (e.g., driving license, knowledge relating to the regulations of the movement, etc.); (3) socio-psychological evaluation of the access and competences by the decision-maker, which is shaped by needs and preferences, and relates to attitudes, values and habits (De Witte et al., 2013; Kaufmann et al., 2004; Zarabi & Lord, 2019). In order to explain the variety of mode choice behaviors among individuals, especially when their access and skills are identical, we need to delve into the way people interpret and act upon their options and conditions. Understanding this process will help in addressing the inconsistency between travel attitudes and/or preferences and behaviors that can influence travel satisfaction (De Vos, 2018, 2019b). It can also explain the "irrationality" of travel behaviors when decisions are made based on personal preferences or habits rather than utility maximization that can be attained by minimizing travel time and costs (Shen et al., 2009).

The discrepancy between mode choice and attitudes towards that mode, known as travel mode dissonance, has garnered attention in recent years (De Vos, 2018; Ye & Titheridge, 2017). It is suggested that a positive attitude towards a certain travel mode increases the probability of preference for this mode, hence, choosing it for a particular trip. However, a mismatch between attitudes and behavior can result in feelings of dissatisfaction as the decision-maker had to choose their non-preferred alternative (De Vos et al., 2016; Festinger, 1957; St-Louis et al., 2014; Ye & Titheridge, 2017). In the present study, we argue that travel mode consonance/dissonance is only one part of the greater travel-related choice[13] (consonance/dissonance, which depends upon not only attitudes but also values that are the underpinning of attitudes (Kollmuss & Agyeman, 2002; Maio & Olson, 2000; Rohan, 2000)

[13] Travel-related choices involve any personal, familial, and professional choice that can influence daily travels. These choices include but are not limited to travel mode, distance, cost, time as well as mobility tool ownership (purchasing or disposing of a car, bike, or public transit ticket), residential location, work and non-work activity locations, marriage, divorce, having a child, and acquiring/disposing of a driver's license.

and to which key decisions in life are more or less related (e.g., residence, car, family, education). In this sense, satisfaction in other travel-related domains possibly decreases the weight of travel mode dissonance and dissatisfaction in determining the overall life satisfaction. In fact, as people have more than one travel-related attitude/value, it is not always feasible to behave in conformity to all of them for various reasons such as budgetary constraints or varying preferences within households. Instead, people are more likely to order attitudes/values by their relative importance and act upon the one which has the strongest weight among the others if their accessibility and competences allow them to—for example, a person/household who has pro-ecological attitude but chooses to drive a car for daily commute because they give higher importance to versatility. It is also important to examine mode-specific attitudes in relation to the wider range of (travel-related) attitudes to which they belong. For instance, while bicycling for commute can be an outcome of a pro-ecological attitude towards cycling (which is a mode-specific attitude), it can be primarily the result of a more leading and influential attitude towards home–work distance (which is a travel-related attitude), resulting in locating residential property within the cycling distance of a workplace (Bohte et al., 2009; X. Cao et al., 2009; Handy et al., 2005). This consideration also helps to control for residential self-selection.

Taken together, the present study targets the travel behavior of more than 10,000 employees of the New McGill University Health Center (MUHC) in Montreal, Canada, who have experienced an involuntary change in their workplace from five different locations within downtown to one peri-central location named the Glen site in 2015. Involuntary workplace relocation can take place when one or multiple job organization(s), at one or multiple location(s), move or merge in(to) another location (Zarabi & Lord, 2019). From the standpoint of the employees, who have very little part in initiating or controlling the move, this relocation is an exogenous life event that can influence their commuting behavior as well as their overall daily mobility. As suggested by numerous studies, a context change (such as a workplace relocation) can increase an individual's consciousness and deliberation in their decision-making (Klöckner & Matthies, 2004; Lanzendorf, 2010; Prillwitz et al., 2007; Scheiner, 2007; Verplanken & Roy, 2016; Verplanken et al., 2008; Wood, Tam, & Witt, 2005; Zarabi & Lord,

2019). Not only have travel habits been found to be susceptible to disruption (Zarabi, Manaugh, et al., 2019), travel-related values and attitudes are also likely to be activated after a behavioral context change (Verplanken & Holland, 2002; Verplanken et al., 2008).

This paper generally examines how the probability of changing commute mode is influenced by an involuntary change in workplace, while also accounting for access and competences, i.e., socio-demographics, transport resources and spatial context. The central focus of this study is on the rationales underlying individuals' travel-related decisions based on their attitudes and values while accounting for the relation between travel satisfaction and overall life satisfaction. To explain the reasons underlying the incongruity between travel attitudes/values and behavior and its influences on travel satisfaction, only a limited number of studies is carried out and most of them have relied on a quantitative approach for their analysis. Although longitudinal quantitative studies make it possible to analyze causality and changes over a longer period of time, many studies have used cross-sectional methods due to their ease and speed of data collection. Additionally, few studies have applied a mixed-method approach in which a qualitative survey complements the findings from the quantitative survey. Qualitative analysis is, therefore, essential to acquire a deeper insight into the complex causal relationships between the subjective (and relative) psychological concepts that cross-sectional quantitative methods are often unable to address thoroughly. The focus of the present study is mainly on a qualitative research, and we also discuss and interact with the retrospective quantitative survey from which our sample for interviews are recruited. This paper begins with a review of existing literature on the concept of weighted decision-making and creates new insights into the links between travel-related attitudes/values, corresponding choices (whether consonant or dissonant), and travel and life satisfaction (Section 2). Section 3 presents the data collection and analytical methods, while the findings are presented in Section 4. Finally, this paper concludes with a discussion of the implications for research and policy (Section 5).

5.3. Literature review

In this section, the concept of weighted decision-making will be presented as a different perspective in explaining travel-related decision-making processes where values and attitudes play a central role. Next, the concept of (travel-related) dissonance/consonance will be discussed. Finally, the link between travel satisfaction and life satisfaction will be reviewed.

5.3.1. Travel-related attitudes, values, and weighted decision-making

Recent transportation literature is substantially devoted to the relationship between behavior and key psychological constructs including attitudes and values, which affect preferences for various short-term and long-term travel-related actions (Clark, Chatterjee, et al., 2016b; Clark, Lyons, et al., 2016; Van Acker et al., 2014; Verplanken & Holland, 2002). From choosing a residential location to a travel route or mode for daily trips, travel-related decisions are influenced by the degree to which the performance of the behavior is positively or negatively valued. The extent to which a valuation leads to an action can be explained through attitude/value–behavior relationships. Values and attitudes are distinguished constructs—both of which can influence behavior. Values are motivational constructs that guide an individual to fulfill a highly abstract goal like security, hedonism, or universalism (Shalom H. Schwartz, 1992; Shalom H. Schwartz & Bilsky, 1990). For instance, protecting the environment and broad-mindedness are two values that fulfill the goal of universalism. Values can influence behavior in three ways: as cognitions that define a situation (e.g., as one in which environmentalism is involved), provoke goals (e.g., universalism), and guide action (e.g., signing a petition in favor of active modes infrastructure) (Verplanken & Holland, 2002). While values relate to abstract, meaning-producing cognitive structures, attitudes are viewed in terms of evaluations of specific and tangible entities (Rohan, 2000). Attitudes are the result of various elements including an individual's underlying value structure. According to Eagly and Chaiken (1993, p. 1): "Attitude is a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor". The evaluation degree can vary from affective and cognitive evaluations (e.g., I like walking for commute, and walking can contribute to

environmental preservation) to behavioral responses (e.g., walking for daily commute or participating in active transport encouraging campaigns) (Bohte et al., 2009). In fact, Eagly and Chaiken (1993) have used the word attitude to describe both tangible and abstract judgments that could be labeled as values. In the present study, we, therefore, use attitude(s)/value(s) when talking about the link between these constructs to travel behavior in general and that of our sample.

Values differ from attitudes in that they transcend tangible entities and are hierarchically ordered with respect to importance (Rohan, 2000). The two constructs are, therefore, measured differently: "Whereas the core characteristic of an attitude is its variation on an evaluation dimension (favorable-unfavorable), the distinctive aspect of a value is its variation in importance" (Verplanken & Holland, 2002, p. 435). For instance, a decision-maker traveler may choose a certain travel mode based on strong health-related values (valuing living healthily and thus cycling to work every day) but does not consider the environmental values of their colleagues negatively. In other words, although this person has a positive attitude towards preserving the environment, it is not as important as keeping a healthy body to become a value. Although values and attitudes are distinct concepts, some attitudes can fulfill a value-expressive function, allowing an individual to express their self-concept (Maio & Olson, 2000). For example, for an individual whose central value is selflessness, this individual may express very positive attitudes towards respecting others' preferences in a household and sacrificing their own convenience in favor of the convenience of others. Although the majority of studies discuss the existence of an order of importance for values (value priority) and not attitudes, some others suggest that people may consider some attitudes to be more important than others (Krosnick, 1988), and the more important an attitude the more likely it is to be stable over a long period of time.

The majority of studies that discussed the role of attitudes in travel behavior decisions focus only on mode-specific attitudes (De Vos, 2018; Kroesen, Handy, & Chorus, 2017) or residential attitudes (X. Cao et al., 2009; De Vos, Derudder, Van Acker, & Witlox, 2012)

without considering the complex interactions with decisions on other travel-related life domains (e.g., car occupation and family). This inclusivity, however, requires an in-depth examination of an individual's access and competences, life-stage circumstances, and personal preferences shaped by both values and attitudes, which is the focus of the present study.

Values may affect one's decision by defining the desirability of outcomes that are related to those values (Ball-Rokeach & Loges, 1996; Feather, 1990, 1992; Verplanken & Svenson, 1997). For instance, a female traveler aged seventy years who makes a choice between 'traveling by car' and 'traveling by bicycle' (value outcome) may decide according to which value she finds more important—i.e., 'maintaining a (relatively) safe trip' vs. 'keeping a healthy body'. In addition, the desirability or attractiveness of a transport mode alternative is defined by the quality of its attributes and their relative importance; and "values may determine the importance of an attribute and, hence, its decision weight" (Verplanken & Holland, 2002, p. 435). Decision weight plays a crucial role in human decision-making processes (Payne, Bettman, & Johnson, 1992; Schwanen & Lucas, 2011; Svenson, 1992). For instance, for attributes of transportation modes, one can refer to cost, speed, punctuality, the availability of seats, air-conditioning, flexibility, safety, carbon dioxide emissions, capability of stimulating physical activity and so on. Therefore, travelers who value (give stronger weight to) preserving the natural environment the most are likely to give more importance to carbon dioxide emissions associated with cars (or even buses), and thus choose walking or cycling.

For attitudes, the story is more or less similar. Table 5.1 (matrix) simply illustrates the concept of weighted decision-making[14] for a decision-maker who wants to select a transport mode between bus, car, and bicycle, and is concerned about three attributes, namely, environmental friendliness, cost, and reliability. To evaluate each transport option, one would choose a common scale as for example 1 to 3. For instance, with respect to environmental friendliness, car rates 1, bus rates 2, and bike rates 3, indicating that a bike is the most environmentally

[14] Decision-making for choosing a transport mode is rather an automatic process for which one may not draw a table. This table only provides clarifications to the concept of weighted decision-making.

friendly mode here. For reliability and cost, the rating involves more subjectivity as one may find a car more reliable than a bike, while for another individual (with different access), a bike is more reliable. Next, the decision-maker assigns importance (weight) to all attributes. In our example, environmental friendliness outweighs cost and then reliability. The value of the weighting will then be multiplied by the value of the attribute for each transport option. Finally, a bicycle is the option with the highest value (16) thus the decision to be made.

Table 5.1 Example of a weighted decision matrix for three travel modes

Attributes	Weighting According to Attitudes/Values	Bus		Car		Bicycle	
		Rating	Total	Rating	Total	Rating	Total
Environmental friendliness	3	2	6	1	3	3	9
Cost	1	2	2	3	3	1	1
Reliability	2	1	2	2	4	3	6
Total			10		10		**16**

People can have more than one mobility-related attitude/value, e.g., towards travel time (e.g., people valuing travel time or people finding travel time wasted time), punctuality, safety, equality, commitment, living healthily, consumerism (not using one's car or paying for gas or parking even in the absence of financial restrictions), preserving the natural environment, etc. These constructs will together influence the choice of preferred travel mode and people may rank each attitude/value differently. This concept of weighted decision-making is otherwise ignored in travel behavior studies that tried to compare various mode-specific attitudes towards each transport mode (see, e.g., De Vos, 2018; Kroesen & Chorus, 2018; Kroesen et al., 2017; Molin, Mokhtarian, & Kroesen, 2016). In the present study, this concept is developed in conjunction with the analysis of the interviews in the qualitative section (section 5.5.3).

In a study by Verplanken and Holland (2002), embedded attitudes that are functionally related to the self and have motivational properties as well as central values were shown to have the ability to predict behavior. Hunecke, Haustein, Grischkat, and Böhler (2007) indicated that mobility-related attitudes have a stronger relation to travel mode choice, whereas values were better predictors of an individual's frequency of mobility, destinations they choose and the distances they cover to reach their destinations. Therefore, it can be hypothesized that values and value-expressive attitudes are more influential in making more 'important' and long-term

decisions (e.g., home ownership or marriage), while attitudes are expected to lead short-term decisions such as choosing a travel mode for a particular trip on a particular day.

It is suggested that values have the capacity to drive behavior and acquire a motivational property if they become central, i.e., a part of one's self-concept (Gatersleben, Murtagh, Cherry, & Watkins, 2019; Verplanken & Holland, 2002). According to the self-activation hypothesis when values incorporated in the self-concept are invoked as a result of context change, they are more likely to guide behavior. Previous research has demonstrated that in a routine context, there is usually a significant gap between an individual's pro-ecological values and their actual behavior. However, individuals with environmental concerns as part of their self-concepts are more likely to make (intentional) pro-environmental value-consistent decisions after their routine travel context is changed. In the present study, we will indicate that a change in work location can be associated with the activation of various travel-related attitudes/values and behaviors.

5.3.2. Dissonance in travel-related choices

Whether it is as favorable to be an attitude or as important to be a value, there are situations where people neither think about their values nor act upon their attitudes while making decisions. This discrepancy between one's action and one's attitudes/values towards that action, often referred to as a value–action gap or dissonance, is otherwise explained by earlier research (Blake, 1999; De Vos, 2018; Kollmuss & Agyeman, 2002; Schwanen & Mokhtarian, 2005). In travel behavior studies, dissonance can be viewed both in terms of residential dissonance and travel mode dissonance. While residential dissonance (i.e., residing in a neighborhood that does not match with one's travel attitudes and residential preferences) has garnered considerable attention in the relevant literature, possible dissonance between the choice of a travel mode and attitudes towards that mode has not yet been analyzed thoroughly. The presence of social norms (that discipline people into behaviors that are at odds with their values and attitudes and that diminish their satisfaction from travel) (Dowling, 2000), constraints in travel-related access (e.g., Cervero & Kockelman, 1997; Reid Ewing & Robert

Cervero, 2010) and a lack of certain skills and competences are found to be significant (Stern, 2000). For instance, an individual with strong positive attitudes towards the environment but insufficient bike riding skill might be forced to use motorized travel modes. Inaccessibility to efficient public transport in a suburban area is also a reason for choosing car over low-carbon transport modes. The presence of perceived behavioral control and perceived social norm (Ajzen, 1991) is also found to be a cause of incongruity between attitude/value and behavior.

Nordlund and Garvill (2002) examine why many people who perceive themselves as "environmentalists" do not translate their attitudes into pro-environmental behavior. The authors suggest that these people are likely to give preference to their immediate interest rather than a long-term collective interest. For instance, it is plausible that a traveler does not sacrifice the comfort, speed and flexibility of a car at the expense of future positive environmental consequences. Moreover, presuming that a pro-environmental action of one person may have insignificant environmental consequences and the negative effects of acting otherwise are uncertain, these individuals are less likely to act upon their pro-environmental attitudes. However, even though walking to work by oneself on a particular morning may contribute only minimally to the reduction of carbon dioxide emissions, such a small action can exert notable, cumulative impact when performed habitually and co-operatively (Verplanken & Wood, 2006). According to social dilemma research, a willingness to make personal sacrifices for common good is positively related to having a cooperative value orientation (Grieco & Urry, 2011). It is, however, important to note that even if a behavior has a positive impact on the environment, it might be performed for other reasons than to preserve the environment—for instance, riding a bike instead of driving a car to stay healthy. In fact, as discussed earlier, individuals not only differ in how they rank the importance of specific values but also in how they may give different weights to their own values (Verplanken & Holland, 2002). For instance, a person who values preserving the environment might use their car for everyday home–work travel. There might be many reasons for this discrepancy. Environmentalism might not be an adequately central value for this person, s/he might not consider a commute trip as one in which environmentalism applies as a value, s/he might enact a competing value

(versatility), or s/he could consider behaving as a pro-environmental person in recycling or composting (Gatersleben et al., 2019) because such behaviors demand lower cost, time, or effort compared to choosing other travel modes (Diekmann & Preisendoerfer, 1992).

Dissonance between behavior and attitude/value not only concerns travel mode choices, which is increasingly studied (De Vos, 2018, 2019b; De Vos et al., 2012), but also pertains to longer-term travel-related decisions such as residential location choice (De Vos, Ettema, & Witlox, 2018). For instance, a mismatch between one's actual neighborhood type and their preferences regarding physical attributes of a residential neighborhood can result in residential dissonance (Schwanen & Mokhtarian, 2005). This means that there are possibly values such as 'freedom' or 'preserving one's public image' and/or attitudes such as 'pro-community-oriented' or 'pro-high density' that are not reflected in the choice possibly due to financial constraints, varying preferences among household members, or exogenous interventions in the neighborhood. Another example of a longer-term travel-related choice is the decision to (or not to) have a child. A person who values family (expansion) might have a positive attitude towards (having) a child. If this person plans to have a child and this desire comes true, the individual is consonant in their (travel-related) choice. During the pregnancy and after the birth, the person may switch from cycling or bus use to walking or decide to purchase a car even if driving is against their pro-environmental values and attitudes. In this context, since the person is consonant with their choice/value of having a child, the unfavorability and dissonance of daily travel is deemed less important. In this regard, the extent to which dissonance in travel domains (e.g., residence, family) or subdomains (e.g., mode) influences one's overall satisfaction and vice versa is arguable. More explanations are provided in the following section.

5.3.3. Satisfaction as a relative concept

In recent years, subjective well-being (SWB) has been one of the focuses of various disciplines including travel behavior. SWB is related to both short-term affective reflections and long-term overall satisfaction with life, which is a cognitive evaluation (Diener, 2009). The affective component mainly refers to the feeling of happiness/unhappiness—that is positive/negative

moods or states that occur during an interval or activity episode (Diener, 2000, 2009; Gilbert & Abdullah, 2004; Pavot, 1993). According to Veenhoven (2012), happiness can also be derived from a specific life domain such as a good job with high salary[15]. Although the effects of monetary choices on happiness are undeniable, these choices are made for managing various other life choices, such as marriage, health, housing, mobility tool ownership, daily travel and activities (Dutt, 2008). In addition, individuals evaluate different aspects of life more importantly than others and so it is important to recognize the extent to which each life domain contributes to life satisfaction. This argument depends upon the value an individual associates with different experiences or domains in life (Sirgy, 2010). In this sense, the overall life satisfaction is the sum of satisfaction in all life domains and sub-domains and, hence, it should be evaluated in an integrated manner. It is, however, suggested that it is not only satisfaction in various domains that can influence life satisfaction (De Vos, 2019a), but life satisfaction can also result in a positive evaluation of life domains (Schimmack, 2005; Schwanen & Wang, 2014). In other words, domain satisfaction and life satisfaction have bidirectional effects (Figure 5.1).

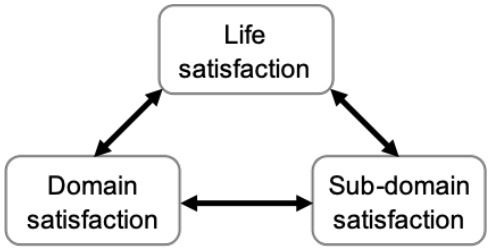


Figure 5.1 Interconnection between sub-domain satisfaction, domain satisfaction, and life satisfaction – Source: Author.

Being deeply ingrained in an individual's everyday life, mobility domain (especially daily commute) and its subdomains relate to both short- and long-term life satisfaction. They not only affect the overall life satisfaction but are also affected by satisfaction in other travel-related

[15] Life domains are the specific, connected, and integrated areas in which people live and interact and which are customized to everyone's unique life. Examples of life domains include residence, neighborhood, health, education, work, family life, leisure and recreation, finance, and travel behavior) (Zhang, 2017).

or non-travel-related domains of life (Zhang, 2017). An individual who is satisfied with their marriage, health, occupation, housing and access to amenities is more likely to be generally happy in life and so does not complain about the inconvenience of their daily commute (e.g., inadequacy of public transit service, cost of gas or parking, traffic congestion, etc.). In addition, one may give more importance to other life domains than mobility for different reasons including socio-demographic conditions, life stages/circumstances, and personal preferences. For instance, a 30-year-old single man who is seriously searching for his first job and is physically and financially capable of traveling with all modes of transportation and who is inherently easy-going with issues like traffic or crowded public transit during rush hours is likely to give lower weight to (the convenience of) daily commute as this valuation might deviate him from moving toward his central goals. Conversely, a 70-year-old female who is highly sociable (likes to participate in activities that are mainly situated around the downtown core) but has no driving and cycling skills may value the ease of accessibility to public transportation over other characteristics of a neighborhood (and even a living space) when searching for a residential property. Therefore, there are central goals and values in life that people invest most of their time and money on achieving and, once these are achieved, the satisfaction that is derived possibly makes other life inadequacies more bearable or even favorable. It is in such situations that behaviors can also affect attitudes—additionally, the reverse causation is generally true (Kroesen & Chorus, 2018; Kroesen et al., 2017). Attitudes/values towards a non-preferred travel-related choice that is frequently made might improve to match performed behavior, possibly to reduce discomfort (Festinger, 1957).

It should be noted that defining and measuring satisfaction is difficult as it is beyond people's objective circumstances such as distance to metro station or ownership of a private vehicle. Although quantitative studies widely accept that life (or travel) satisfaction can be measured saying, "Overall, how satisfied are you with your life (or daily travel) these days?", qualitative approaches enable a more complex evaluation of this relative concept. Satisfaction is, indeed, a subjective experience that depends upon one's perceptions and feelings and includes both cognitive judgments and affective reactions (Diener, 2009). To the authors' knowledge, there

is no mixed-method study to date on how travel-related domains interrelate, and to which extent each one of them contributes to overall life satisfaction for different individuals.

5.4. Methodology

This study applies a mixed-method (quantitative and qualitative) approach to collect and analyze the data on mode specific attitudes and travel mode dissonance (quantitative) and other travel-related attitudes/values that influence travel and life satisfaction (qualitative). Using the same dataset as the Chapter 4 of this dissertation (online questionnaire of the Mobility Survey of the McGill University Health Center (MUHC)), this Chapter first analyzes questions regarding travel-related attitudes, commute satisfaction and overall life satisfaction (section 5.5.1). On the last page of the online questionnaire, respondents were asked to provide their email address and/or telephone number if they are interested in being contacted for a face-to-face interview. A total of 101 respondents provided their contact information—of which, only 19 consented to participating in a one-hour long interview. The interviews were conducted between September and December 2018 with the 19 employees at the Glen site. Results are discussed in section 5.5.2.

5.5. Findings

5.5.1. Quantitative results

Based on different quantitative surveys (see, e.g., Cuignet et al., 2019; De Vos, 2018; Enaux & Gerber, 2014; Gerber, Thériault, Enaux, & Carpentier-Postel, 2018), 42 variables of transport mode attitudes are built on a five-tier semantic differential scale and down to seven attitudes: speed, cost, ecology, comfort, safety, relaxation, and reliability, which are examined for six modes: bus, metro, train, car, bicycle and walk. This question provides a general overview of preferences and compares the employee's attitudes towards different transport modes, whether or not the person uses the mode (Figure 5.2).

For each seven attitudes, a numerical ordinal score between 1 to 5 is assigned (see, e.g., Handy et al., 2005) – the sum of which gives a total score between 7 to 35, a measure for mode-specific attitudes (see, e.g., Kroesen et al., 2017). According to the observed results, the overall attitudes towards walking present the highest (positive) score with 24.99, followed by attitudes towards metro (24.17) and train (23.95) while the other modes ranked lower with cycling (22.55), car (21.28), and finally bus (21.07). Generally, attitudes towards active modes present the highest score in other studies, but the score coming from attitudes towards metro and train coming before cycling is not usual (De Vos, 2018)[16]. This finding can be, at least partially, accredited to: (1) the accessibility of metro and train services at the Glen site compared to the five older MUHC sites; (2) the relatively insufficient accessibility for bike riders due to road closures and constructions, congestion, and the existence of the highways surrounding the Glen site. This argument suggests that behaviors and travel experiences can also affect attitudes – additionally, the reverse causation is generally true.

Name of the Transport Mode: Car, Bus, Metro, Train, Bicycle, Walk					
	Strongly Agree	Agree	Neutral	Agree	Strongly Agree	
Fast					**Slow**
Expensive					**Cheap**
Ecological					**Polluting**
Uncomfortable					**Comfortable**
Dangerous					**Secure**
Tiring					**Relaxing**
Reliable					**Unreliable**

Figure 5.2 Measuring participants' attitudes towards six transport modes (six separate tables) - "Q: What do you think of each transport mode even if you do not use it? (For each transport mode, opposing qualifications (good or bad attributes) are provided. For each pair of qualifiers, check the box that best matches your opinion.)".

As expected, people using the train and metro have a significantly higher score (based on Chi square tests and analysis of variance and Fisher test also called the 'Anova F-test') regarding attitudes towards these modes compared to those using other modes (Table 5.2). For instance, train commuters score 27.02 for train-related attitudes. The F-test is significantly different

[16] The fact that the number of bike riders—who answered this question—is relatively small is also an important factor that should be taken into account in the interpretation of the results.

(with the *p*-value $p < 0.001$) from the other groups of transport mode choices: ($F(5, 1066) = 36.226, p < 0.001$), where 5 and 1066 represent the degrees of freedom regarding the five other groups of transport modes and the number of people involved in the other groups respectively, and 36.226 is the ratio between the mean squares resulting from the variance between groups and the variance within groups. For car users, the car-related attitude was 23.109, which is significantly different compared to that of the entire surveyed people with 21.336 ($F(5, 1064) = 29.319$, $p < 0.001$). This significant difference in the total average was observed for all transport modes.

Table 5.2 Summary of overall transport mode attitudes by groups of transport mode commuters

		Bus Attitudes	**Metro Attitudes**	**Train Attitudes**	**Car Attitudes**	**Bike Attitudes**	**Walk Attitudes**
Car	Average	20,414	23,097	23,243	23,109	21,605	23,746
	N	343	341	341	340	339	339
	SD	3633	3588	3182	3640	3502	4106
	Median	20	23	23	**23**	21	23
Bus	Average	22,891	24,324	23,190	21,431	22,052	24,652
	N	211	210	211	211	210	210
	SD	3597	3816	3088	3634	3780	4545
	Median	**23**	24	22	21	21	24
Metro	Average	21,201	25,328	23,291	20,494	22,822	25,388
	N	259	259	258	259	258	258
	SD	3939	4137	3429	3702	4010	4235
	Median	21	**25**	22	21	22	25
Train	Average	19,442	23,814	26,948	19,741	21,818	25,265
	N	172	172	172	170	170	170
	SD	3688	3682	3313	4015	3663	4275
	Median	20	24	**27**	20	21	25
Bike	Average	22,294	25,314	24,020	18,667	28,882	22,294
	N	51	51	51	51	51	51
	SD	4346	3927	3850	4546	3609	4346
	Median	22	25	23	19	**29**	27
Walking	Average	21,342	24,158	23,289	21,395	24,553	29,053
	N	38	38	38	38	38	38
	SD	3130	3530	3479	2871	3391	4172
	Median	22	24	22	21	25	**30**
Total	Average	**21,057**	**24,135**	**23,878**	**21,336**	**22,475**	**24,912**
	N	1074	1071	1071	1069	1066	1066
	SD	3892	3893	3551	3980	4026	4410
	Median	**21**	**24**	**23**	**21**	**22**	**25**

In order to estimate whether an employee could be dissonant or consonant about their commuting transport mode, we have considered several types of thresholds based on the transport mode used and the (normal) distribution we obtained for each overall transport mode

attitude. One of the simplest thresholds can be derived from data classification related to a normal distribution, which is the difference between the average and the standard deviation:

$$T_{TM} = \hat{x}_{TM} + 0.5\delta \quad (1)$$

where *TM* is an index for the transport mode and T_{TM} is the threshold. For example, for car users, this gives a threshold of (23.109 + 0.5 × 3.640) = 24.93, meaning that car commuters with an attitude score of 24.93 or more are considered as more or less dissonant. Table 5.3 summarizes this element for all modes.

Table 5.3 Dissonant and consonant participants with respect to commute mode choice.

	Car Users	Bus Users	Metro Users	Train Users	Bicyclists	Pedestrians	Total
Consonant	81.9	72.7	82.8	76.8	70.6	90	79.1
Dissonant	18.1	27.3	17.2	23.2	29.4	10	20.9
Total	100	100	100	100	100	100	100

In total, we observed that nearly 80% of the respondents are consonant. Among all, bus users are found to have the most dissonant commuters (27%) as opposed to metro users with only 17% dissonant commuters.

The Chi-square between commute satisfaction and the dissonance variable is highly significant ($p < 0.001$, Cramer Phi = 0.160). The variables linked to travel satisfaction are based on a two-part question capturing satisfaction and its comparison between a situation before and after workplace relocation: 'Overall, how satisfied are you with your typical daily commute—before the relocation to the Glen site/after the relocation to the Glen site?' The question was presented as a 5-point Likert scale, from 'very satisfied' to 'very unsatisfied'. Commuting satisfaction has increased between the two considered periods. Nearly 70% of the respondents are currently satisfied or very satisfied with their commute to work compared to 59.3% before the relocation, testifying to a general improvement of the travel conditions, or at least of its perception.

Regarding the overall life satisfaction, respondents were questioned: "Taking all things into account, how satisfied are you with your life these days?" The question was presented as a 5-point Likert scale, from 'very satisfied' to 'very unsatisfied'. More significant associations

were found between life satisfaction and age group (Chi-Square = 0.026, $p < 0.05$, Cramer Phi = 0.093), as well as types of employment (Chi-Square = 0.004, $p < 0.01$, Cramer Phi = 0.118). One of the most explanatory variables relies on travel satisfaction after workplace relocation (Chi-Square = 0.000, $p < 0.001$, Cramer Phi = 0.160), with an expected outcome: the more satisfying the commute, the greater the life satisfaction, and vice versa. This result corroborates to the general idea that life satisfaction and domain satisfaction are mutually correlated. However, the meaning behind this relationship has to be explored in detail with qualitative data.

5.5.2. In-depth interviews, data collection and analysis

Although quantitative data in general potentially allows for examining causality, online questionnaires, even those with retrospective questions, as in the present study, are less capable of understanding changes and processes over time compared to longitudinal data. One reason is that lengthy questionnaires that contain detailed questions regarding various aspects of causality are time-consuming and can cause participant frustration and drop out. In the present study, the online questionnaire was relatively extensive since it concerned the situations of the respondents both before and after the move. Discovering the complex relationships and interactions between travel-related attitudes/values, mode choice, and satisfaction that are shaped throughout the time requires the use of qualitative methods as a complementary approach that allows for the in-depth evaluation of such subjective and relative concepts (De Vos, 2019a; Lanzendorf, 2010; Ogilvie & Jones, 2012; Thomas, Walker, & Musselwhite, 2014). In the present study, the preliminary framework and the closed questions of the online questionnaire did not present sufficiently structured concepts concerning the underlying rationales for travel-related and commute mode choice and left us with various hypotheses in the discussion section of Chapter 4. In the present Chapter, too, for instance, we found that 80% of the respondents are consonant, whereas 70% of the respondents are satisfied commute-wise, showing that there still exist consonant commuters who are unsatisfied with their commute (we also found dissonant but satisfied commuters). Thus, the second stage of the

study required a qualitative approach, in the form of detailed semi-structured interviews. Findings from this section can indeed be used for exploring and developing new hypotheses to be examined in quantitative analyses.

The sample, composed of four men and fifteen women, reflects a range of ages between 27 and 80, household structures, income level and profession category (Table 5.4). The interviews were based on open-ended questions enabling the respondents to speak freely about their daily (old and new) work and non-work trips and those of their household members, the relevant experiences and challenges, other travel-related events during the last couple of years (e.g., residential mobility, car ownership, etc.), reasons underlying any change (or not) around the relocation, travel-related values and attitudes and level of travel and life satisfaction before and after the move of their workplace. Regarding the data analysis, first, the audio-recorded interviews were transliterated, and the sociodemographic characteristics of the respondents were presented in Table 5.4. Next, all the interview manuscripts were recoded based on the study objectives and the key variables to be examined. Coding was carried out with the help of the QDA Miner, a specialized software for analyzing qualitative data. The participants were given pseudonyms.

Table 5.4 Socio-demographic characteristics of the respondents

Characteristics		**Cases**
Gender	Male	4
	Female	15
Age (years)	25–34	4
	35–44	4
	45–54	7
	55–64	1
	65 and more	3
Education	Secondary level and below	3
	Diploma/College	3
	Undergraduate degree	8
	Master's degree	1
	Ph.D. degree	4
Number of children in household	0	7
	1	2
	2 or more	10
Household type	Single	1
	Couple without children	6
	Couple with children	12

Employment status	Full-time	15
	Part-time	3
	Night shifts only	1
Total	∑	19

5.5.3. Qualitative exploration of attitudes/values, dissonance and satisfaction

This section presents an analysis of the data from the interviews centered upon the key elements of utility maximization and weighted decision-making set out in the theoretical background section. Based on the travel-related priorities of the interviewees and the attitudes/values underlying their corresponding decisions (refer to table 5.1 for more explanations), five categories of decision-makers are distinguished and analyzed in detail. Elements of dissonance/consonance and satisfaction are also discussed accordingly (Table 5.5).

Table 5.5 Profiles of participants and different categorizations according to decision weights, consonance and satisfaction level

Participant	Characteristics		Commute Mode		First Ranked Attitude/Value	Residential Satisfaction	Commute Disso./Conso.	Commute Satisfaction
	Age	HH Composition	Before *	After				
1. Olivia	28	Couple, no child	Car	Car	Home ownership	Satisfied	Somewhat dissonant	Satisfied
2. Isabelle	51	Couple with four children	PT	PT	Living space and neighborhood	Satisfied	Dissonant	Dissatisfied
3. Ava	27	Couple, no children	PT	PT	Pro-environmental	Satisfied	Consonant	Satisfied
4. Emma	33	Couple with one child and one expecting	PT	PT/car during pregnancy	Pro-environmental	Satisfied	Dissonant	Somewhat dissatisfied
5. Camila	38	Couple with two children	PT	PT/walk	Pro-environmental	Satisfied	Consonant	Satisfied
6. Elizabeth	51	Couple with two children	PT/Bike	PT/Bike/walk	Pro-environmental	Satisfied	Consonant	Satisfied
7. Sophia	68	Couple, no children	PT	PT	Pro-environmental	Satisfied	Consonant	Satisfied
8. Mila	41	Single	PT	Car/PT	Minimizing costs	Satisfied	Consonant	Somewhat dissatisfied
9. Jane	45	Couple with two children	PT	PT	Minimizing costs	Satisfied	Consonant	Somewhat dissatisfied
10. Zoe	52	Couple with two children	Car/PT	PT	Minimizing costs	Somewhat dissatisfied	Dissonant	Somewhat dissatisfied
11. Rachel	61	Couple with one child	Car	PT/Bike	Minimizing costs	Somewhat dissatisfied	Somewhat dissonant	Somewhat dissatisfied
12. Abigail	35	Couple with two children	PT	Multimodal	Spouse's and children's satisfaction	Satisfied	Somewhat dissonant	Satisfied
13. John	48	Couple with four children	Car	Bike/PT	Spouse's and children's satisfaction	Somewhat dissatisfied	Somewhat dissonant	Somewhat satisfied
14. Linda	27	Couple, no children	PT	PT	Convenience and speed	Satisfied	Consonant	Satisfied
15. Mia	36	Couple with two children	PT	Car	Convenience and speed	Satisfied	Consonant	Somewhat dissatisfied
16. Hannah	48	Couple with two children	PT/Being driven	PT/Being driven	Convenience and speed	Satisfied	Somewhat dissonant	Somewhat satisfied
17. Benjamin	53	Couple with two children	PT	PT/Bike	Convenience and speed	Satisfied	Consonant	Satisfied
18. George	69	Couple, no children	PT/Bike	Car	Convenience and speed	Satisfied	Dissonant	Somewhat satisfied
19. William	80	Couple, no children	Walk	Car/PT	Convenience and speed	Somewhat satisfied	Somewhat dissonant	Somewhat satisfied

HH Composition = Household Composition – PT = Public Transport (Train, Metro, Bus)—* Before and after the relocation of the MUHC.

5.5.3.1. Home ownership/location is more important than any travel disutility

The first group belongs to two participants, Olivia and Isabelle, for whom home ownership/location outweighed any possible travel disutility.

> *Q: "So, why did you choose this location for your current home?"*
> *A: "It was the low mortgage cost versus everything else … I can't get anything in the city with a bit of land for under one hundred fifty thousand dollars." (Olivia, Age 27)*

Olivia is a nurse who only works night shifts and drives a car four days a week for a home–work distance of ninety-five kilometers; a three-hour round-trip commute that costs her four hundred dollars of gas and one hundred dollars of parking per month not to mention the costs of maintenance and insurance.

Prior to moving to her current home, Olivia experienced commuting to the Glen site from three other locations (North, West, and South) within the Greater Montreal[17] and, from each home, she chose driving over other transport modes, even when she had the opportunity to have a twenty-minute train commute. In fact, neither the residential nor the workplace relocations (as major life events) stimulated a change in behavior nor weakened her strong habit of car use (Zarabi, Manaugh, et al., 2019). In addition, working nights and also having a car, Olivia preferred driving to ensure having a seat (compared to jam-packed rush-hour public transit) in a morning when she could not have enough sleep the night before. Olivia also admitted that she is not a day person, thus daytime commute is not an option for her, which is why she opted for a nighttime job in the first place. Olivia also highlighted that her job is stable, whereas her partner's is more flexible. This provided them with less constraints in finding viable neighborhoods in which to search for a new property. With his skills and competences, Olivia's partner can choose different careers at different locations or even stay at home with their future children if necessary.

Olivia perceived the MUHC "super-hospital" as a prestigious organization where being an employee is a value that fulfills her feelings of self-esteem, pride, and satisfaction. She believed that working at this well-known hospital is worth the long commute and the costs. Olivia referred

[17] Greater Montreal is referred to as the Montreal Island (the inner and densely populated area) and its surrounding lower-density municipalities which are located on the fringe of Metropolitan Montreal.

to her commute time as her "alone time", "girl time", or the time in which she can have her own space to think about herself.

> *"I always wanted to be part of the 'big' hospital. I always wanted to be part of advancing research … I feel like a sense of pride when I tell people that I work at the super-hospital. Everybody knows the super-hospital. You know, so, I tell them I work for the Children's or I work at the Glen and they'll say "Oh, the super hospital!"." (Olivia, Age 27)*

For Olivia, travel environmental concerns had a lower value weight compared to home ownership and the reputation of working for the MUHC, her two central values. Surprisingly, the price of her car was almost the same as her house, confirming the fact that one may pay any expenses to achieve a central goal. Recycling, composting, and implementing solar panels in her backyard were examples of actions that Olivia performed in order to enact her environmental concerns.

For Isabelle, the story is in some respect different. Aged fifty-one, Isabelle lives with her spouse and four children in a large, detached house, on a small island near Montreal, thirty kilometers west of the MUHC. Isabelle is a full-time administrative technician who relies tremendously on public transit for morning and afternoon commutes. Two buses and a metro take her to and from the Glen in almost four hours per day—i.e., one-third of the time she spends out of home. Isabelle enumerated various dissatisfactory elements associated with bus use and admitted that these challenges can be sufficient for some people to move their home closer to their workplace.

Six years before the relocation of the MUHC, when Isabelle and her husband bought their current house, they knew about the future location of the Glen and could afford to rent or buy in closer proximity to the workplace of all household members. However, giving prominence to certain characteristics of a residential neighborhood decreased the importance of home–work travels.

> *Q: "Do you ever plan to relocate your home because of all these situations?"*
> *A: "No. We like where we are. We're still part of the Montreal. But we feel like we're a little separate because it's an island. We have a little bridge. I think that If I was a single elderly woman, I wouldn't stay there. But because we're family we're all out there. I really like it there. Buying a house in Montreal? There's no way I can afford anything around here. We went where the prices were reasonable, where you know things were more convenient." (Isabelle, Age 51)*

Despite her positive stance towards environmental protection, Isabelle's travel-related decision did not reflect her attitudes. She acknowledged that the ownership of only one vehicle which is chiefly

used by her spouse—whose workplace was situated seventy kilometers to the south—has forced Isabelle to use public transit. Once she can afford a car, she would either drive to work or to the train station to save time.

In sum, looking at the two above-mentioned cases, one may find various attributes of travel mode such as cost, convenience, and eco-friendliness to be important in making commute-related decisions. However, the utility/satisfaction that Olivia and Isabelle gained from home ownership and residing in their preferred house and neighborhood outweighed the disutility of wasting time, money, and energy during the daily commute. In other words, Olivia's and Isabelle's choices and behaviors may not seem rational from an economic or ecological perspective, but rather satisfactory. With respect to the questions of 'commute satisfaction' and 'overall life satisfaction', both participants had selected 'neutral' and 'satisfied' respectively on a 5-point Likert scale in the online questionnaire. However, the interviews revealed that these responses are highly relative and subjective as Olivia was found distinctively happier regarding her commute as opposed to Isabelle who perceived her home–work trips as 'horrible'.

5.5.3.2. Environmentalism underlies every travel-related decision

For five of the participants (Emma, Elizabeth, Camila, Sophia, Ava), pro-environmental attitudes/values guide their (travel-related) behavior distinctively compared to others. The interviews revealed that environmental concerns have more or less influenced long-term and short-term travel-related decisions including the choice of home location, vehicle ownership, non-work activity spaces, and daily commute. Among the first priorities in locating a residential neighborhood, these participants referred to walkability and accessibility to public transport and amenities. Elizabeth highlighted that having grown up in the suburbs, her husband and herself had negative experiences from extensive automobile dependency. These experiences together with their strong ecological concerns morally motivated Elizabeth and her spouse to stay downtown to minimize their pollution while taking the advantage of having a short home–work distance. Similarly, Emma acknowledged that having grown up in another city, she finds driving in Montreal to be comparatively "stressful" and "aggressive". Outweighing the accessibility and possibility of walking to work to home ownership, Emma rented an apartment within one-and-a-half kilometer of the Glen site. In addition, Elizabeth, Emma, Camila, and Ava emphasized that the ownership of

only one car, that is fuel efficient, was an intentional choice resulting from their feelings of moral obligation to act pro-environmentally.

> *"I owned a car before. But when we moved in, we decided to keep only one car because we still need to go to the country house during the weekend. But the choice of disposing one car is that I'm a big environmentalist." (Ava, Age 27)*

Interestingly, all participants of this category were found to be more or less proactive in their home location decisions when anticipating the future of their workplace[18]. For instance, in her last year of study at university, Ava decided to move in with her partner. Knowing that her chance of finding a job at the MUHC is the highest among other medical centers in Montreal, she sought for residential locations in close proximity to the Glen and within walking distance of a metro station. Camila who also expected a baby started to search for a larger home around the Glen two years in advance in order to avoid "getting confined" by the new travel constraints. Even Elizabeth, who moved to her current home fifteen years before the relocation of the MUHC, prioritized accessibility to her future workplace and limited her search to central neighborhoods.

> *"The fact that my children, my spouse and I are close to work and in biking distance of work and school is more important than having a big backyard. … At that point they did not have a land site chosen but it was very clear that because of the trauma center status and the level of care that we deliver we would be staying within the downtown core." (Elizabeth, Age 51)*

It can be argued that an environmentalist individual who is subconsciously concerned about the future of the planet is more likely to contemplate their own future life situations, too. Anticipating any probable changes and challenges, these people are more prone to take actions proactively to avoid obligations to act against their pro-ecological values and attitudes. Furthermore, an individual who always cares about the common good is more likely to consciously make co-operative choices (based on altruistic values) at any time he/she makes a decision (Grieco & Urry, 2011). The common acknowledgement among these participants was that the choice of low-carbon transportation modes, especially for commute, was the outcome of conforming to inherent pro-ecological values.

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[18] In the late 1990s, scattered news about the building of a new MUHC at a site named "Glen site" emerged. As a result, the majority of the employees who worked at the MUHC at that time were more or less informed about an eventual relocation of their workplace.

"Definitely my husband and I we care about the environmental impact that we have. So, this is primarily reason why we try to stick to public transport as opposed to using our vehicle that has gas emissions. So, I mean I wouldn't say it's like something that we think about. I think it's just instinctually what we're concerned about." (Camila, Age 38)
Q: Will you be ever interested in green-transportation incentives?
A: "It wouldn't affect me because I'm going to do it anyway … I know what I value." (Sophia, Age 68)

These findings corroborate the value-belief-norm theory of environmentalism—i.e., feelings of moral obligation to act pro-environmentally are the outcome of values (e.g., altruistic values) and environmental beliefs (i.e., awareness of the behavior's negative influences on the environment and feeling responsible to act upon that) (Stern et al., 1999; Stern, 2000). According to Kollmuss and Agyeman (2002), individuals' priorities are defined according to their feelings of responsibility, which are shaped by values and attitudes. If people's pro-ecological values are in alignment with their priorities—i.e., their own well-being and the well-being of their family—the motivation to act upon the priorities increases (e.g., residing in cycling distance of the children's school). If they contradict each other, the priorities will less likely be followed (e.g., not to purchase a car, even though one could afford to buy one). This argument is comparatively true for the participants of this category for whom pro-environmental values are central to the self and, when activated (by anticipating their workplace relocation), are regulated value-congruent behavior (Verplanken & Holland, 2002).

5.5.3.3. Maximizing utility equals minimizing costs

Q: "Why do you use public transport and your husband take the car?"
A: "We did the math. He could go to work in a different way but it's actually cheaper for him to drive than purchase the train and bus pass. For me, it's the opposite." (Jane, Age 45)

For Jane, Mila, Zoe, and Rachel, commuting behavior can be better explained through the utility maximization theory from an economic perspective. As economics theorize, when making a choice from various alternatives, individuals attempt to get the greatest value possible from the expenditure of the least amount of money. This often happens when the individual's income or resources are limited, and they have to select the combination of choices that is most affordable to maximize their utility. For example, the choice of locating a low-rent residential property in an

urban fringe and spending more on transportation versus living in an expensive apartment within the city but paying less on transportation by relying on walking and cycling.

> *"I think our next step will be to purchase a home. And that is a big discussion at home. Do we stay within the city, or do we move out to a more rural area which is a dream of ours? But the cost of accessibility to Montreal core is something to be considered also because we will maintain having one vehicle only." (Jane, Age 45)*

Jane is an administrative technician who lives with her husband and two sons (both at the legal driving age). With a relatively low household income, for Jane, minimizing the household expenditure, especially on transportation, is one of the first priorities that she tried to realize primarily through residential self-selection and maintaining the ownership of one vehicle. Jane emphasized the "rationality" of her decisions that helped optimize their income and expenses, a strategy that maximized the entire household's utility and satisfaction—i.e., the choice of residing in a low-rent apartment in a mixed-use, transit-oriented neighborhood and locating job, school, and daily activities of the household members within the close proximity of their residence. Jane also referred to the "time loss in traffic congestion" as "a waste of money" and pointed to her tendency to prevent her children from driving as an indication of her strong economic concerns.

Mila, a forty-one-year-old, single, health and social professional, moved out from her parents' home to shorten her commute after the relocation of the MUHC, a reduction from three hours to thirty minutes per day. Mila works at two sites, (1) the Glen, to which she takes the train, and (2) the MUHC administrative building to which she drives her car. Choosing her current home location was an attempt to maximize her accessibility to one of the least congested highways that goes to her second workplace, a main train station that goes directly to the Glen, and her leisure activities. Mila acknowledged that in spite of the recently added rent to her monthly expenses, she gains more utility in saving travel time and gas for work and non-work trips. She managed to use the extra time for earning money in a sport class where she is a trainer.

Zoe and Rachel (fifty-two and sixty-one-year-old administrative technicians) shifted from a car-based commute at their former workplace to a public and active transport-based commute at the Glen site. For Zoe and Rachel, the choice of car was utilitarian up until the parking fees exceeded the public transit fares. In fact, taking into account the costs of gas, parking and maintenance, they outweighed the monetary benefits of public transport (especially bus) to the flexibility, speed, and

reliability of car commuting. Zoe emphasized that the only driving force to take low-carbon transport modes is the household's financial restrictions and environmental concerns play no role whatsoever in this regard.

> *Q: "Do you have any environmental concerns when you use public transportation?"*
> *A: "I think everybody's gonna say of course I care about environment but come on now it's cheap and I don't want the hassle of accidentally parking somewhere where I can't park and then get a ticket." (Zoe, Age 52)*

Rachel also took advantage of riding her bicycle to work for seven months during the non-snow seasons. She underlined that a "simple calculation (of time and cost) can make a big difference". Comparing a one-hour long bike ride (one way) to a forty-five-minute-long public transit journey, Rachel preferred the former alternative for two reasons: (1) "for a fifteen-minute extra (commute time), I can save almost eight hundred dollars per year" and (2) "I'll save a lot of money on the gym as the bike is already my cardiovascular exercise".

Although one may argue that minimizing costs to maximize utility is everyone's desire, the aforementioned cases are highly distinctive from other participants in this respect. For instance, both Jane and Zoe highlighted that the joy of shopping at diverse or special but remote shopping centers is not worth the gas to travel that extra distance. However, they may go to several stores in their vicinity to take advantage of the best deals. Finally, any travel mode consonance is not necessarily associated with travel satisfaction. Although the choice of public transit is the most utilitarian for Zoe, it is still somewhat unsatisfying due to the inadequacies of public transit. In fact, she is a good example of an individual who is choosing between bad and worse for her commute mode.

5.5.3.4. "My family is my priority; I will adapt myself"

John is a forty-eight-year-old nurse who lives with his wife and four children, twenty-seven kilometers south-west of the Glen site. For John, the accessibility and convenience of the household outweighed his own ease of access to work. A three-hour round commute trip by bicycle was John's biggest challenge after the relocation of the MUHC to the Glen site. Although riding a bicycle was in line with John's pro-environmental and pro-health attitudes, he complained about a six-kilometer additional commute distance after the move. He also raised many criticisms on the inapproachability of the Glen as a result of road closures, constructions and congestion.

Prior to the relocation of the MUHC, John used his private car for commute, which exposed him to extensive parking availability and cost challenges, leading him to experience strong feelings of dissatisfaction for commute trips. Therefore, he changed his job twice to adjust his work schedule and commute routines to that of his household members. He believed that in a household of six, the existence of at least one flexible member is essential for "the whole system to work". John highlighted that the choice of their current residence was mainly determined by the workplace of his spouse and the location of the school and extracurricular activities of their children.

> *"We moved three times but in the same neighborhood … of course, it is relatively less expensive here but, more importantly, the environment was safer to raise a family." (John, Age 48)*

Similar to John, Abigail, a thirty-five-year-old pharmacist, put the preferences of her spouse and two children ("personal life") before her convenience ("work life"). She acknowledged that having a "selfless" personality, she can easily ignore her travel satisfaction in favor of the household's sense of "contentment" and "happiness". Especially, after the birth of her children, the importance of having a short commute was substituted by the ease of access to grandparents. Although Abigail relocated home immediately after the relocation of the MUHC, she enumerated various non-MUHC-related factors (e.g., larger living space, proximity to parks and shopping) to be as key determinants in their decision.

5.5.3.5. Convenience and speed weigh significantly more

Undoubtedly, convenience and speed are everyone's interests when it comes to repetitive work travel. However, the extent to which an individual gives prominence to travel convenience and speed at the expense of other factors (residence, environment, cost, and family) can be argued. In six cases of the sample we analyzed—George, William, Hannah, Benjamin, Mia, and Linda—the significance of convenience and speed for everyday commute played a substantial role in residential location and vehicle ownership decisions.

George and William, two physicians with similar socio-economic characteristics (both above sixty-five years old, live only with their wife, above-average annual household income) switched from active to car-based commuting after the relocation of their workplace. Currently living within walking distance of a major public transit station, George can take the train and William can take

the metro to reach the Glen site in approximately forty-five minutes with a reduced fare for the elderly. However, having experienced a longer commute distance and a different route after the relocation of the MUHC, both participants switched to driving to maintain the speed and convenience of their daily travel within a certain level. For example, although the new cost of commute including parking, gas, and maintenance, has increased six-fold, George acknowledged that he has no choice but to pay for his safety and convenience. Similar to Zoe, he seemed to be caught between a rock and a hard place where his choice of commute mode is only practical rather than satisfactory.

> *"I did actually take my bike to work at the old site for about six to eight years. I stopped doing that when I came to the Glen because I didn't want to be killed in the highway. So, it was for my personal safety. If I take auxiliary roads, it takes much longer. I am concerned about fossil fuels but, I feel two hours commute per day is just not something that I can handle at this stage." (George, Age 69)*

William also works at a private clinic within walking distance of his principal workplace, the Glen site. He explained how the nature of his job necessitates the use of car on certain days of the week. Having to carry some delicate objects like "biopsy specimen" between home, the Glen and his private office, he prefers to drive or be driven by his wife to transport the biopsies safely. On other days, however, positive attributes of a car such as air-conditioning, flexibility, independence, and "access to underground parking next to the elevators" overshadow the low cost and ecological sustainability of public transport.

Mia, a thirty-seven-year-old nurse who lives with her husband and two children, relocated home in anticipation of the relocation of the MUHC. The household's first determinant factor in the residential move was shortening of the commute distance for everyone. For this purpose, the location of the children's schools was also chosen on the route from home to the Glen and Mia's husband's workplace. Therefore, having located all the destinations close to each other and in one direction, the entire household's commute is completed (morning and afternoon) on a single trip with everyone in one car. However, Mia confessed that not only can she and her husband easily use public transit, but their children can also use the school bus for commute. Mia who had the least ecological concerns among all was an admirer of driving. She explained that even though public transit is easily accessible and cheaper, it is not comparable with car regarding, speed, reliability, air conditioning and entertainment for the children.

> *"I'm not going to go out of my way to make a decision for the environment. ... If you want to convince me to take the public transport, you're going to make the public transport faster and more convenient than if I was taking the car and not much more expensive unless it's a lot more comfortable." (Mia, Age 36)*

This distinctive appeal for speed and convenience was not limited to car users. Benjamin, Hannah, and Linda were three public/active transport users who self-selected their commute mode irrespective of its advantages vis-à-vis environment, cost or family.

A couple of years prior to the relocation of the MUHC, Benjamin and his family relocated home for two main reasons: having a larger living space and residing within walking distance of a metro station. When the latter condition was met, Benjamin disposed of his second car as all four members of the household were able to commute using the same metro line. Benjamin acknowledged that even though the cost of four public transit passes is equal to, if not higher than, the gas and parking expenses of car commuting (car-sharing like Mia), they would rather avoid time loss and the stress of getting stuck in traffic. Conveniently, for Benjamin himself, access to the Glen site is straight with no transfer between lines. Benjamin explained that he had also tried driving and cycling to work. Whereas driving is "time-consuming and exhausting", cycling is pleasurable and advantageous for his health, hence, it is his preferred alternative during the summer. However, Benjamin admitted that ecological concerns play a minor role in his decision for his use of low-carbon transport modes.

> *"Nothing is more important than having a commute time within a certain threshold, the faster the better ... Car is for when I have to visit multiple sites in one day. That's way more convenient than other means. ... I'm not taking my car and I take the subway because I want to save the planet? It's there somewhere but it's probably the last one." (Benjamin, Age 53)*

Hannah is a forty-eight-year-old administrative technician, who changed her home two years after the relocation of the MUHC. Although the impetus for this home relocation was a non-job-related factor, the choice of the neighborhood was determined merely by the importance of commute convenience and distance for Hannah, as, from their home relocation, the other three household members (husband and two children) did not benefit commute-wise. However, notwithstanding that the new home was within a thirty-minute walking distance of the Glen site, Hannah asked her husband—who was unemployed at that time—to drive her to work for more than one year. Finally,

with her husband finding a job, Hannah switched to public and active transport, commuting without any intention for environmental preservation or saving money.

> *"At that time of day [bus and metro] is like super packed in like sardines. And I hated it. It was awful. So, when my husband stopped working, I was like, "do you mind giving me a ride?" I switched to public transport only because it's more convenient parking wise, time wise, traffic wise." (Hannah, Age 48)*

Finally, Linda was the only participant who never considered driving as an option for commute as she never opted for a driving license. Being raised in a transit-oriented neighborhood, Linda has always appreciated the capability of performing her daily activities by walking or bus and metro. Therefore, when deciding to relocate home in 2015, her first priority was maintaining accessibility to public transport and walkability to amenities and services. However, even though Linda and her partner can largely save money and also contribute to environmental preservation by public/active transport use, she admitted that the only driving force to remain a non-car user is the convenience and the dislike of cars that originates from childhood experiences.

> *"It's more pleasant to sit with the phone or with the book in the Metro than to be in a wheel and trust and not knowing where to go because Turcot is closed, something else is closed. Everything around the Glen is Closed. I just chose to never never get my license." (Linda, Age 27)*

For the six cases we analyzed in this group, the convenience and duration of commute trips outweighed other key elements such as cost (George, William, Mia and Linda), environment (Mia, Benjamin, Linda), and family (Hannah). These individuals managed their commute trip to be short, straight and with minimum transfers between lines.

5.5.4. Synthesis of the results

Our analyses indicated that people tend to have both more than one travel attitude (towards mode, route, distance, time, direction) and travel-related attitudes/values including the ones towards preserving the environment, spending/saving money, health (having physical activity through daily transport), home ownership (as an essential investment), residential location (accessibility, density, tranquility, family-oriented), and everyone's satisfaction in a household. However, not only do people differ in how they rank the importance of specific attitudes/values, but they are also likely to assign different weights to their own attitudes/values, which eventually influences the

way they experience feelings of satisfaction (Figure 5.3). Commuters such as William who express negative feelings about being stuck in congestion and experiencing stress may feel satisfied overall as they can make efficient use of time by being more multitasking compared to cycling or public transport. In fact, the utility gained in saving time outweighs the disutility of feeling stress. Although Olivia had pro-ecological and pro-health concerns, too, her stronger inclination toward home ownership as an essential investment led her to rank 'preserving the environment' and 'having physical activity' the second and the third, respectively. Therefore, to maximize her feelings of satisfaction, she chose to purchase a house where she could afford it—a very distant neighborhood from the city that was only accessible to work by car. This choice, however, overshadowed her desire to respect the environment or perform some exercise through daily public/active commuting. Additionally, as Figure 5.3 illustrates, the existence of barriers and facilitators, i.e., socio-demographic characteristics, spatio-temporal accessibility, and skills and competences, can influence one's capability to act upon their attitudes/values in their order of importance. For instance, for Isabelle, the self-selection of a residential neighborhood (as the first priority) which is inaccessible by adequate public transit facility results in the element of 'travel convenience' to be negatively overshadowed. Emma, who was also pregnant at the time of the survey, highlighted that the occasional reduced mobility has forced her to be driven to work by her spouse. For some participants, the existence of barriers caused them to adopt new attitudes or even values in some cases. For instance, George who has reached a sensitive age for bicycling prioritized the value of security over environmentalism and thus changed his commuting from many years of bicycling to car use after the relocation of his workplace. This finding is in line with the results from De Vos et al. (2018), who suggest that travel attitudes are likely to change after relocation. Using a quantitative analysis, this study suggests that travel attitudes vary across individuals depending on the spatial characteristics of the current and previous locations. Our qualitative analysis revealed that in addition to spatial characteristics (e.g., passing through a highway for the new home–work route for George), the socio-demographic characteristics, skills/competences, and habits of the individual also play a role in how travel attitudes/values change.

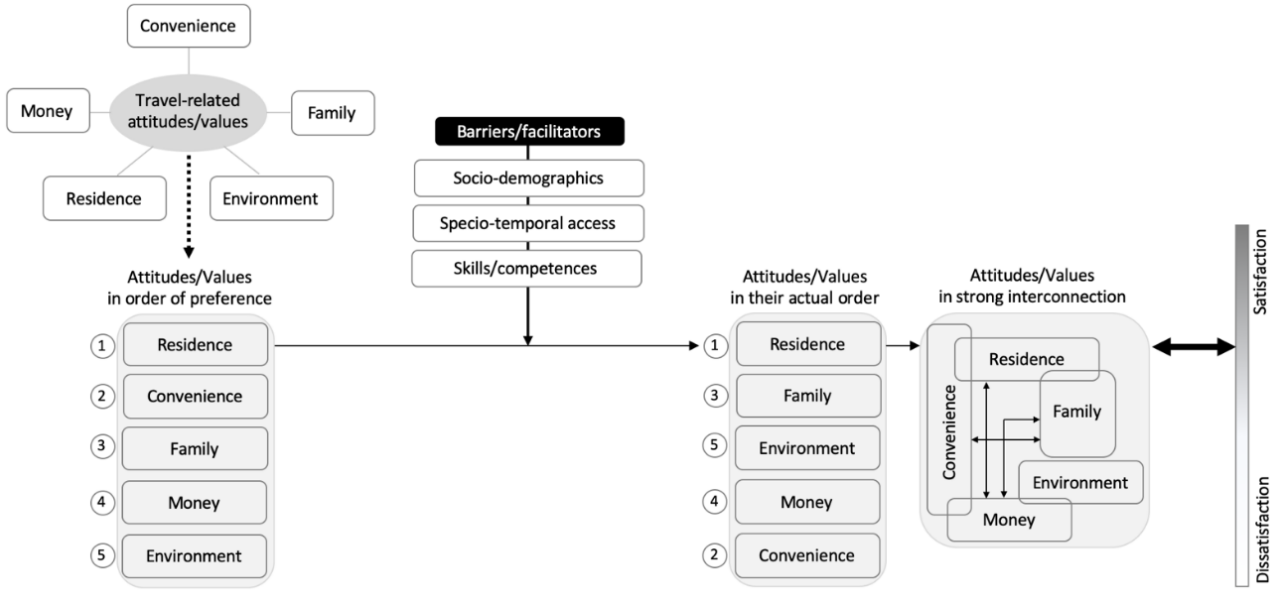


Figure 5.3 Weighted decision-making and the interconnection between travel-related domains and satisfaction—The example of Isabelle – Source: Author.

Furthermore, our analyses highlighted that travel-related choices and the corresponding attitudes/values are strongly interconnected to one another, i.e., one life choice may not only be the outcome of other life choices but also influence other life choices (Zhang, 2017). For example, although locating her residence in a particular neighborhood is the first priority for Isabelle, meeting the desire of all household members (i.e., the element of family) constructs a salient part of this decision. The choice of active modes for commute may not only result from residential location choice but also lead to reluctance to participate in and travel to sport classes after work (the case of Rachel and Benjamin). Preserving the natural environment cannot only result from recycling and composting (the case of Olivia) but also life choices such as driving an electric vehicle for daily commute, which then provides flexibility in performing more complex trip chains such as pick up/drop offs of the children (the case of Abigail).

5.6. Discussion and Conclusions

Using quantitative and qualitative data from the commuting behavior of the MUHC employees (Montreal, Canada) we have analyzed how attitudes/values play a role in travel-related decision-making processes and the extent to which corresponding dissonance/consonance affects or is affected by the overall travel-related satisfaction. Similar to previous studies, the quantitative results indicated that mode-specific attitudes play a substantial role in choosing that mode for

commute. Respondents using a certain commute mode have significantly more positive attitudes towards that mode compared to commuters who use other modes. By analyzing mode-specific attitudes for six modes (car, train, metro, bus, bicycle, walk), we found that only 20 percent of the respondents are commuting by travel modes which are not matched to their attitudes. Among these dissonant commuters, bus users constitute the biggest share and metro users the smallest. Surprisingly and contrary to the results from previous studies, the share of dissonant active mode users was relatively high compared to other modes (except bus). These findings can be, at least partially, accredited to: (1) the accessibility of metro and train services at the Glen site compared to the four older MUHC sites; (2) the relatively insufficient accessibility for bike riders due to road closures and constructions, congestion, and the existence of the highways that surround the Glen site. Furthermore, we found that whereas 80% of the respondents are consonant, 70% of the respondents are satisfied commute-wise, showing that there still exist consonant commuters who are unsatisfied with their commute (we also found dissonant but satisfied commuters). This finding is in contradiction with that of De Vos (2018), who argues that it is not the chosen mode itself that influences travel satisfaction, but whether the chosen mode is in consonance with attitudes towards that mode. Dissonance-satisfaction suggests that people can have a relative preference for more than one mode or their satisfaction results from non-mode-related domains such as travel route or time or a friend who accompanies them. Consonance-dissatisfaction can be an outcome of a temporary inadequacy related to the mode used (e.g., road closures, temporary out-of-service train facility) or due to dissatisfaction vis-à-vis non-mode travel attributes (e.g., route, direction (towards/against traffic congestion), distance, departure/arrival time).

In conformance with our quantitative findings, results from our qualitative analysis revealed that dissonance between the choice of a travel mode and attitudes towards that mode does not always mean that the mode used is the non-preferred one (Emma, George, William, Zoe, Rachel, John, Hannah). Even though a certain mode might be the most preferred one (in an ideal situation), individuals might choose the "second-best, somewhat less positively valued" transport mode (De Vos, 2018, p. 271). George and Emma are examples of individuals with strong pro-environmental values who are currently driving their private vehicle every day because they are enacting a competing value, maintaining health and security (George is above sixty-five, and Emma is pregnant). In fact, the choice of a car is more utilitarian (rather than actually (highly) satisfying or being in congruence with their attitudes toward car) at this stage of their life. It is in such situations

that—besides an effect of attitudes on behavior—travel behavior can also influence attitudes (see, e.g., De Vos, 2018; Kroesen et al., 2017; Tardiff, 1977).

From the standpoint of a weighted decision-making process, our study highlighted that as people have more than one travel(-related) attitude/value, it is not always feasible to behave in conformity to all of them. Instead, people are more likely to act upon the attitude/value which has the strongest weight among the others if their access and competences allow them to. Depending on the weight that individuals attach to their attitudes, they may assess different attitudinal aspects of a decision more importantly than others. Therefore, it can be argued that consonance/dissonance and satisfaction are not absolute concepts, but rather relative, and depend on the weight one may attribute to different attitudes/values which may also vary at different stages of life. These results also provide valuable insights into the relationship between travel-related choices and travel satisfaction. Among the sample of cases we analyzed, Olivia has positive attitudes towards home ownership, environment and health. But the weight of home ownership for Olivia is stronger than for the other two. Therefore, even though her financial resources (access) do not allow her to act upon all three attitudes at the same time (purchasing a house within walking or cycling distance of the MUHC), Olivia feels highly satisfied (and consonant) because her first priority/value is met. Recycling, composting and doing some exercise on the weekends are examples of actions that she performs in order to remain congruent with her other two attitudes. For two of our cyclist participants, Rachel and John, inaccessibility to safe roads during the snow seasons resulted in different levels of travel dissatisfaction. For John who ranks the 'household's satisfaction' first, the inability to cycle for commute is less dissatisfying compared to Rachel who considers cycling as a means of 'saving money', the value she ranks the first. This finding is in line with Zhang (2017)'s life-oriented approach, which considers the possible contingencies among individuals and suggests that the effects of similar choices may vary across persons and situations. Therefore, it is essential that policy makers find out what works best for whom, when, and where.

Although this study has provided valuable information regarding the link between mode-specific attitudes, consonant/dissonant commuters' mode choice, and commute satisfaction, future studies can provide additional insight. As illustrated in Table 5.1, significant attention should be paid to the construction of measures analyzing (i) travel mode preference; and (ii) travel-related preferences. Both mode-specific attitudes and travel-related attitudes/values should be analyzed

using measures that include weight attribution to each travel mode perception and each travel-related attitude/value, respectively. In fact, ranking attitudes in their order of importance makes it possible to clearly represent a preference for a certain mode or a certain travel-related choice. Moreover, this also enables the creation of a more detailed measure of dissonance in both travel mode and travel-related choices, which allows for a better evaluation of travel satisfaction and life satisfaction. While transportation plays a vital role in meeting individuals' various needs, it is just one part of people's life choices in a sense that satisfaction in other life domains can make a travel dissatisfaction bearable (or even favorable) (the cases of Isabelle and Zoe). Although the qualitative analysis of travel-related dissonance and corresponding level of satisfaction used in this study provides a straightforward evaluation of the typologies of individuals vis-à-vis factors affecting their satisfaction, future mixed-method studies are required that include a more detailed examination of other travel-related domains (e.g., family formation) while allowing for generalization to large populations. It should also be considered that travel satisfaction is not only a function of mode satisfaction but also travel route, direction, time (departure/arrival) and distance—each of which might have a different level of importance in one's travel mode selection process. Moreover, using longitudinal data—which is relatively less dominant in travel behavior/satisfaction studies—makes it possible to analyze the importance of life satisfaction as an explanatory variable of domain and subdomain satisfaction. On the other hand, longitudinal data also enables accounting for the interconnection between potential changes in domain satisfaction and life satisfaction over a longer period of time.

Finally, future studies should account for a wider range of travel-related dimensions including spatial, familial and professional factors and examine them by considering the interactions between household members and their needs, abilities and preferences, which can constrain the use of a preferred mode, and thereby affect travel satisfaction. Doing so, insights can be gained on the causes, dimensions and consequences of travel-related choice dissonance and dissatisfaction. In this regard, more qualitative studies that apply in-depth interviews with all household members could also provide valuable information. The evidence from this study offers three important implications for future sustainable planning practice that attempt to encourage less automobile dependency and more public/active transport use by adopting behavior change strategies. First, policy makers should pay special attention to factors that determine travellers' priorities (vis-à-vis their travel decisions) especially in cases of relocation as travel-related attitudes/values are more

likely to be changed and guide behavior during such life events. Second, interventions should focus on dissonant and dissatisfied travelers, as these individuals are more likely to change their behavior. Finally, transport research should avoid individualistic frameworks and think about how individuals' attitudes are co-constituted by (and co-evolve with those by) household/family members and social networks, while taking into account the various factors that influence household's life stage (e.g., age, composition, financial situation).

6. Chapter Six: Conclusion

6.1. Summary of chapters

This dissertation explored how travel-related responses – particularly daily home-work trips – to an involuntary workplace relocation contribute to understanding the choice of household's daily mobility in a metropolitan area in an attempt to guide mobility towards a more sustainable path. For this study, the case of McGill University Health Center (MUHC) – an agglomeration of five health establishments in Montreal – was chosen. Over 10,000 employees had to change their place of work to the Glen site (Vendôme intermodal station). Following the introductory and the research methodology chapters, the first study (Chapter 3) conducts a systematic literature review to present the current scientific and empirical perspectives on commuting behavior influences of involuntary workplace displacements by reviewing 22 studies from various countries across the world. Having the key determinants of commute mode choice and change (both objective and subjective variables) identified in the third chapter, the second study (Chapter 4) examined the commute mode choice and satisfaction for 7500 commuters of the MUHC in Montreal, Canada, who experienced an involuntary job relocation in 2015. This study tried to assess mainly the objective variables using quantitative approaches, while the third study (Chapter 5) applied both quantitative and qualitative methods to examine the subjective determinants of modal choice, commute trips and life satisfaction.

Of particular novelty and importance of this study is its focus on workplace relocation, and more specifically the (spatial) merger of five separate hospitals in a new hospital located with good public transportation connections near Montreal's central city. The case was effectively a natural experiment of what happens when employment is moved to a central location with improved accessibility by environmentally sustainable forms of transportation. Considering that the majority of empirical studies on mobility impacts of workplace relocation focused on decentralization, the present case study added value to the related literature. In addition to the geographical uniqueness of the MUHC before and after the move, the case study was also significant with regards to characteristics of the target population. With a unique temporal ordering for thousands of people traveling to/from it (not only the employees but also the patients and their relatives) and the

diversity of occupation categories (from doctors to service jobs) that exist, the case has significant implication with respect to transport mode usage and choice making which are explained below.

The overarching empirical finding of this research is that the habit-disruptive event of the relocation has, on balance, made more people commute by environmentally sustainable modes of transportation while also improving their satisfaction with travel – a result that will be appreciated by advocates of New Urbanism, Smart Growth and integrated land use and transportation planning. The same is true for the finding that public transport is associated with greater average satisfaction levels post-relocation than commuting by privately owned car. The underlying reasons for this are firstly attributed to the improved built environment characteristics – including accessibility and transport service – at the new location compared to the old one and secondly to the heavy congestion on the under-construction roads surrounding the Glen site. The MUHC is established in a fairly central location with good access by commuter rail, metro, and bus lines and the site is adjacent to a neighborhood that has high sidewalk coverage and protected bicycle lanes. However, while the existence of a regional train (in addition to metro and bus) at a major workplace has a positive impact on reducing private automobile use, the simple existence of alternatives is insufficient and further efforts are needed to reduce car-based commute and encourage the use of low-carbon transport modes.

More specifically, Chapter 3 provided insight into, first, the current understanding of the factors affecting the commuting pattern and mode choice of individuals following forced workplace relocations, and second, the effective measures recommended or adopted so far to incentivize sustainable transportation and less private-automobile dependency for daily commute. This Chapter demonstrated that in addition to the built environment characteristics (e.g., density, distance, transportation service) which are widely studied and paid attention to by the majority of travel behavior literature, travel-related psychological factors (e.g., attitudes) and socioeconomic characteristics also play substantial role in shaping individual's modal choice decisions in the context of an involuntary relocation (which is taken into account by only a few studies). In addition, surprisingly, none of the studied papers assessed the important influence of commute satisfaction in defining mode choice, a variable that is distinctively highlighted and has proved to be an important determinant by the general travel behavior literature. From the reviewed papers, the most influential variables that determine the share of employees who choose to drive for

commute are: 1) access to high-quality public transit, 2) access to (free) parking, 3) access to roads system, and 4) home–work distance. In the aggregate, most of the studied publications (17 of 23 studies) concluded that workplace displacement is associated with a significant modal shift—from 15% to 75%—from public and active transport to car use. This finding is not surprising, as most cases involved relocations from the Central Business District (CBD) to a suburb; in cases where the relocation took place in the reverse direction or within the city, switching to public transit for commuting was also higher. Accordingly, certain policy measures such as charging parking fees at workplace or car sharing were recommended by some of the studies as strategies to discourage automobile dependency. Overall, the study highlights that, the involuntary displacement of workplaces can result in significant changes in transportation patterns and demand both at the organization level and in the area of the new location. Therefore, in order to increase low-carbon transport mode shifts, workplace localization strategies should consider optimal accessibility to transport services and activity opportunities at both the local and regional scales, based on the type of job to be relocated (e.g., employees' income level, socio-professional situations, working hours, etc.).

In response to the lack of consensus on the determinants of commuting behavior change/choice of an involuntary workplace relocation, Chapter 4 examined the identified variables (or a modified version of them) from the third chapter, along with two variables missing in the literature i.e., commute satisfaction and life satisfaction in the context of a major workplace (hospital) relocation in the Montreal metropolitan region. This case study, which contrary to the majority of the studied literature, took place within the city – by merging five workplaces in the CBD into one pericentral location – revealed new insights into the commuting pattern influences of a forced workplace relocation. Data was collected using a retrospective online questionnaire (N = 1,977; response rate: ~26%). Using binomial regression models, the study developed five models of modal choice and two models of trip satisfaction (satisfied versus others) to compare modal choice and commute satisfaction across five different transport modes (car, bus, metro, train, active transport (walking and bicycle)). Results demonstrated that modal choice and commute satisfaction are not only mutually dependent but can also be influenced independently by some of the studied determinants. Among all socioeconomic variables, occupation type showed to be distinctively important in defining modal choice and commute satisfaction levels possibly due to the particular working shifts and education level associated with being mostly doctors, nurses and other health

professionals in our case. Among the studied spatio-temporal characteristics, our findings were in conformity with those of the systematic review in that an improved accessibility to quality public transit (particularly the existence of a train with an underground tunnel) along with the road closures around the new workplace were the most significant factors that explained the increased share of public transit ridership among the employees. Additionally, the variable of travel time (both perceived and actual) found to be distinctively important in defining commute satisfaction in a sense that travel duration – irrespective of the chosen mode and home-work distance – influences commute satisfaction. Similarly, our results highlighted that the likelihood of choosing public transit over car increases when proximity to public transit (especially metro) is combined with having a shorter commute time by metro than by private automobile. These findings corroborate with those of the previous literature by emphasizing on the importance of accessibility to frequent and reliable transit service and transit-oriented developments. Although the variable of travel time has been widely studied by the previous literature, it was mainly examined in static situations or without regard for life events (as also shown in Chapter 3, commute distance – even though can be a good representative of commute time – was used rather than travel time). Our results indicated that longer commute times (over 40 minutes) and bus use were positively related whereas no significant association was found between residing outside of the Greater Montreal or in the South ring (both representing far distances from the MUHC) and bus use. This implies that even employees with short home-work distance can experience very long commute time which then results in low commute satisfaction especially when people tend to compare their before- and after-the-move commutes when answering the questionnaire. Therefore, it is suggested that future studies account for both travel time and distance when assessing changes in travel behavior and satisfaction. Furthermore, the study indicated that a strategic relocation of a workplace can, of course, increase both the use of low-carbon transport modes and the commute satisfaction level among the employees. Although the former workplaces were located in downtown – which is often perceived to be more accessible by public transit than the rest of a city – the existence of a regional train station in addition to the metro and bus facilities, together with extensive road constructions and the corresponding heavy congestion around the new workplace resulted in a significant increase in sustainable travel modes use. Overall, the study highlighted the significance of certain travel and geographical characteristics as well as the important role of the occupation type of the

relocated employees when studying a workplace relocation, a variable which was ignored by the previous literature.

Building on and complementing these results, Chapter 5 essentially focused on modal choice and commute satisfaction from a subjective perspective. Using the same dataset as Chapter 4, and both quantitative and qualitative analyses, this study examined the respondents' mode-specific attitudes, their level of attitudinal congruence with the chosen commute mode (consonance/dissonance), and the impacts on their commute and overall life satisfaction. Results from the quantitative section demonstrated that the extent to which a travel mode dissonance contributes to travel dissatisfaction can vary for different individuals as some dissonant commuters showed to be unsatisfied and some satisfied with their commute. Using data from 19 face-to-face semi-structured interviews with employees recruited from the mentioned sample, the second section of the study delved into the complex causalities and rationales underlying travel-related choices and changes by analyzing the way people interpret and act upon their options and conditions in order to address the inconsistency between travel attitudes and behaviors that can influence commute satisfaction. In conformance with our quantitative findings, results from our qualitative analysis revealed that dissonance between the choice of a commute mode and attitudes towards that mode does not always mean that the mode used is the non-preferred one. Even though a certain mode might be the most preferred one (in an ideal situation), individuals might choose the second-best, but still positively appreciated transport mode as they have other priorities as well as constraints in life. A pregnant woman with strong environmental concerns against car use may temporarily drive to work because she enacts a competing value, maintaining health and security during the nine-month pregnancy. In fact, the choice of a car is more utilitarian (rather than actually (highly) satisfying) at this stage of her life. In that sense, consonance and satisfaction in other life domains can make a commute dissatisfaction bearable or even favorable. To this end, this study proposed the concept of weighted decision-making as the state-of-the-art in travel behavior research that concern measuring attitudes, consonance/dissonance, and satisfaction. This approach helped to better understand how individuals rank and prioritize their travel-related attitudes and values within the various domains of life in order to maximize their life satisfaction specially when experiencing a context change.

Of other significant values added by the unique case study was the result of behavior analysis of employees with atypical work schedules, e.g., night shift, hence, with atypical commute time. Traveling in the opposite direction of traffic flow both in the morning and afternoon, along with accessibility to more (free) parking spaces, possibly stimulate private automobile use which should be taken into consideration by planners. Although not significant in number, hence, we cannot generalize the results, qualitative examination of such cases opens new avenues for future research.

6.2. Theoretical and methodological contributions

This study contributed to the advancement of knowledge in three sets of literature: First, the previous work on the consequences of the involuntary employ relocation, second, the literature on mobility biographies and third, the literature on the interrelations of people's travel behavior, attitudes and values, and satisfaction with travel.

With regards to the first contribution, findings from our case study supported the results of the systematic literature review in that geographical and infrastructural factors are a bigger determinant of commuting behavior after such disruptive event than internal cognitions and socio-demographic variables; whether a person started traveling by metro after the relocation depended far more on the presence of metro infrastructure than it did on attitudes to metro commuting. Although the present model did not include both the spatial and attitudinal factors in one model, the finding that demographic variables were poor predictors of behavior change at least lends further implicit support to these claims that the workplace built environment is of prime importance in commuting behaviors. In particular, the fact that the MUHC's relocation was associated with the presence of a regional train and better access to metro (through an underground tunnel) had plausibly an influence on mode switching from car to public transit.

Second, the study offers an important extension to the mobility biographies literature (e.g., Lanzendorf, 2003; Larouche, Charles Rodriguez, Nayakarathna, & Scott, 2020; Müggenburg et al., 2015; Salomon, 1983; Scheiner, 2007, 2018). Previous studies have mainly concentrated on private domains such as residential relocation or the acquisition or giving up of a private car than on professional domains (Müggenburg et al., 2015). In professional domain, the two events of retirement and entry into the labor have received greater attention. The present study indicated that an involuntary workplace relocation not only affects the accessibility and mobility domains

(including residential biography) but also the life-style domain to a great extent. For some employees, the relocation of the MUHC served as a key event that triggered the need for residential relocation or changing the mobility tool ownership. For instance, of those who reported different number of cars before and after the MUHC's relocation, 56.4% made this decision either directly or indirectly because of the relocation. In addition, many employees reported reconsideration of their decisions vis-à-vis child's daycare/school location, having a baby, taking retirement, and changing job in response to the MUHC's relocation. To this end, it is expected that transport policies and practices are more effective as habits – as a key determinant of commuting behaviors – are likely to be disrupted and attentiveness to alternative transport modes will be increased. Given the large proportion of studies showing statistically significant changes (Larouche et al., 2020), major life events are highlighted as "windows of opportunity" for travel behavior change.

Third, another major contribution of this dissertation is its focus on dynamics in the relationships between transport modus on one hand and attitudes, values and subjective wellbeing on the other. These relationships are usually interrogated in static situations or without regard for life events. By introducing and applying the concept of weighted decision-making, this study indicated that travel satisfaction and life satisfaction can be realized by maximizing satisfaction in the domains that are one's priority. These domains (e.g., travel, job, family, residence, money, etc.) can interchangeably replace one another at different stages of one's life depending on age, household composition, financial situation and so on. If attitudes or values with highest level of importance for a person can be followed or acted upon, it is highly likely that the negative feelings of other domains (with less importance) not being fulfilled will diminish to a great extent. Therefore, the person's overall feeling would be satisfaction. An individual who attributes the strongest value weight to environmentalism and having physical activity may pay higher costs to perform his daily commute using an electric bicycle. Therefore, the negative aspect of having a costly commute is compensated and overshadowed by the positive feeling of acting upon the desirable values mentioned. The qualitative part of the present study categorized the interviewees with respect to their most important travel-related values and discussed how achieving these values can help increase their life satisfaction, notwithstanding attitude/value weights and satisfaction levels are relative and may vary among different characteristics of individuals and during different life stages as mentioned above. These categories – which certainly can be expanded to more life domains – can be used in future quantitative surveys which aim at investigating modal choice behaviors and

related consonance/dissonance and satisfaction determinants. In this context, the current study offers an important extension to the literature on travel behavior, attitudes and values, and satisfaction with travel.

The study is also significant in that it to brings attention to the importance of simultaneous consideration of both objective and subjective determinants of modal choice in travel behavior research and practice. Whereas the important role of objective variables such as the built environment characteristics (e.g., distance and transportation services) is quite evident to the researchers of this field, it is as essential to account for subjective elements such as attitudes, values, and habits. This will help us to assess how individuals and households evaluate and act upon their travel options and geographical accessibilities based upon their socioeconomic and psychological characteristics. Furthermore, this research contributed to the advancement of knowledge by introducing the concept of weighted decision-making to the research of mobility, especially modal choice and commute behavior and then by examining it in a qualitative approach. Using open-ended questions in face-to-face interviews allowed us to discover – or at least emphasize – the fact that economic and budgetary concerns are only one element in determining households' travel-related decisions as other values such as social prestige, convenience, ecological concerns and the environment where the children are raised possibly play a stronger role in such decisions. In addition, the life stage at which the household lives (e.g., pregnancy or just being divorced) at the time of the survey can sometimes significantly influence travel-related decisions especially when the life event coincides with the event under investigation in the research (e.g., workplace relocation in our case). These examinations help researchers to more accurately explain the "irrationality" of travel behaviors when decisions are made based on personal-familial values and priorities rather than utility maximization that can be attained by minimizing travel time and costs. Although a few studies have previously discussed this concept implicitly (Schwanen & Lucas, 2011; Verplanken & Holland, 2002), no study has explicitly assessed commute-related choices (not only mode choice but also residential location, car ownership, familial decisions, etc.) from this perspective. Therefore, we encourage future quantitative studies to enrich questionnaires by putting these observations into perspective and including them in their analysis. It should be noted, however, that measuring mode-specific attitudes and values using the concept of weighted decision-making (explained in Chapter 5, section 5.3.1.) has still some limitations that require further investigations in future research. For instance, for some individuals,

the relative or absolute importance of certain values such as ideological or religious values cannot be rated as simply as other values such as cost and convenience – especially in quantitative surveys.

Finally, this dissertation emphasizes the importance of applying both quantitative and qualitative research methods when studying individuals' behaviors, be it with respect to modal choice or other travel-related domains of life. Although quantitative data in general potentially allows for examining causality, online questionnaires, even those with retrospective questions, as in Chapter 4 of the present dissertation, are less capable of understanding changes and processes over time compared to longitudinal data. One reason is that lengthy questionnaires that contain detailed questions regarding various aspects of causality are time-consuming and can cause participant frustration and drop out. In the present dissertation, the online questionnaire was relatively extensive since it concerned the situations of the respondents both before and after the relocation. Discovering the complex relationships and interactions between travel-related attitudes/values, mode choice, and satisfaction that are shaped throughout the time requires the use of qualitative methods as a complementary approach that allows for the in-depth evaluation of such subjective and relative concepts. Furthermore, findings from our qualitative analysis can indeed be used for exploring and developing new hypotheses to be examined in the future quantitative analyses. To the author's knowledge, no study exists on mobility impacts of workplace relocation that have applied mixed methods approach. In this regard, this dissertation provides a valuable methodological contribution.

6.3. Policy implications

Of main concerns in this dissertation is the gap that exists between travel behavior – particularly home-work travels – research and implementation of the research outcomes into the real world of practice. The relocation of the MUHC and the 22 cases studied in the systematic literature review indicated that mobility impacts of workplace displacements can indeed provide valuable implications for sustainable Travel Demand Management (TDM). The underlying principle is that the relocation of a workplace often results in significant alterations in transportation patterns and demand (number of trips, mode choice, trip length) of the relocated individuals and in the area surrounding the old and the new locations. Therefore, workplace localization strategies should consider primarily facilitating a better accessibility to public and active transport services and

activity opportunities – compared to the former location(s) – at both the local and regional scale by considering the occupation type to be relocated (e.g., employees' income and education level, socio-professional situations, working hours, etc.). Next, the relocation strategies need to account for both the various objective and subjective factors that influence the adaptation of short- and long-term commute-related decisions, such as mode switching, mobility tool ownership, residential relocation, and familial decisions. If these factors converge with strategic policies attempting to integrate land use and transportation, this can help reduce the substantial reliance on private vehicles for commuting journeys, and thus mitigate the negative impacts on the built environment and on individuals' health.

Additionally, and more importantly, this dissertation provides valuable insight into the policy implications that relate to the mobility biographies approach. The relocation of the MUHC in 2015 showed to affect important aspects from the routine personal and professional life of more than 10,000 employees even a couple of years after the move. The change of home-work distance, travel time, number of transfers between lines, access to activity opportunities (restaurants, bank, shopping) that many employees habitually travel to during the launch time, the feasibility of children drop off/pick up on the commute are only a few examples of the changes that provoked the need and desire to consciously reconsider the before-the-move modal choice and other travel-related habits by the employees and their households. In this context, transportation planners and policy makers who aim at changing commuting behaviors towards more sustainability can highly benefit from the so-called vulnerable phase, i.e., before, during, and after the relocation – in which people are more attentive seekers, hence, likely to accept new alternatives and adopt more sustainable travel-related habits.

6.4. Future research

While this dissertation has filled some important gaps, several challenges still remain to further support the understanding of the choices of households' daily mobility in a metropolitan territory. Although the relocation of the MUHC has been more or less successful with respect to increasing the use of public transport at the new site (the Glen), the investigations highlighted the need and potential for studying, examining and implementing various TDM measures to improve sustainable transport, specifically daily commute, and the employees' quality of life. With more

than 10,000 employees (not to mention the number of patients and their visitors who travel to and from this location), the MUHC super-hospital is as populated as a small town and an important trip attractor/generator which plays a prominent role in the mobility debate. The super-hospital composed of employees with various job categories including administration professionals/technicians, health and social professionals/technicians, doctors, nurses, and service and volunteer staff. This diversity creates an exceptional situation regarding generating typical and non-typical commute trips (e.g., for those who work during the night or weekends). In this context, future studies can be conducted to answer the following research question: "How can low-carbon transport measures be promoted and implemented into current commute patterns of the MUHC employees in a way that both typical and non-typical travel demands will be addressed?" To answer this question, pursing the following objectives is key: 1) Identifying appropriate measures of TDM to be used in transport planning practice and the main barriers to the implementation of those in practice (in various contexts including work locations); 2) Generating metrics of sustainable TDM that fit the needs and preferences of the MUHC employees in collaboration with local transport planners.

Taking into account the on-going life-changing event of the COVID-19, future studies on the MUHC employees – as front-line workers who did not have the option to telework during the pandemic – will provide valuable insights. Much of the research on COVID-19 and travel has examined society in general and the many individuals who could switch to teleworking. However, understanding the changes made to travel and why they occurred can help support sustainable transportation after the pandemic or during future such events. Despite the dominance of teleworking during the coronavirus pandemic (Kylili et al., 2020), the health sector employees were generally obliged to travel to work (except for certain administrative jobs). However, the overall reduction of daily trips across the Montreal metropolitan area resulted in considerably less congested roads and streets. In addition, worries over public transit and desires for being outdoors could highly stimulate car use, bicycling, and even walking for commute. The new during-pandemic perspective allows for understanding the mobility influences of an exogenous event that has affected the employees and their households in various ways and helps to make a comparison between the two situations (before, i.e., results of the present doctoral thesis, and during). The various influences of the pandemic on the job conditions (e.g., heavier workload) as well as familial, social and economic situations of the employees and their households (e.g., loss of job,

emotional stress, shrinking of the activity space, etc.) make it possible to observe the scenarios put into action by households in their routines.

Additionally, while the present research focused solely on transportation changes associated with involuntary workplace relocation, a comparative study between voluntary and involuntary workplace relocation can reveal valuable insights into the complexity of mobility decisions during different life transitions. It can be hypothesized that individuals will act and adapt differently in response to self-selected and controllable relocations compared to forced ones. Additionally, workplace-related changes in commuting behavior may occur as a result of a change in an existing workplace geographical context, such as the opening of a new railway station adjacent to an organization (see, e.g. Brockman & Fox, 2011; Wen et al., 2005) or the termination of road closures and constructions surrounding a workplace, as will take place in the near future for the case of the MUHC. Conducting more research from this perspective can also be worthwhile.

Furthermore, although this research – by applying the weighted decision-making approach qualitatively – has provided promising information regarding the link between mode-specific attitudes, consonance/dissonance, and satisfaction, future studies can provide additional insight. Significant attention should be paid to the construction of measures analyzing both travel mode attitudes, and travel-related priorities. Both mode-specific attitudes and travel-related attitudes/values should be analyzed quantitatively using measures that include weight attribution to perceptions, attitudes and values. In fact, ranking attitudes in their order of importance makes it possible to clearly represent a preference for a certain mode or a certain travel-related choice. Additionally, this enables the creation of a more detailed measure of dissonance in both travel mode and travel-related choices, which allows for a better evaluation of travel satisfaction and life satisfaction. Although the qualitative analysis of commute-related dissonance and corresponding level of satisfaction used in this study provides a straightforward evaluation of the typologies of individuals vis-à-vis factors affecting their satisfaction, future mixed-method studies are required that include a more detailed examination of other travel-related domains (e.g., family formation) while allowing for generalization to large populations. It should also be considered that commute satisfaction is not only a function of mode satisfaction but also home-work route, direction, time (departure/arrival) and distance—each of which might have a different level of importance in one's commute mode selection process. Furthermore, using longitudinal data—which is relatively less

dominant in travel behavior/satisfaction studies—makes it possible to analyze the importance of life satisfaction as an explanatory variable of domain and subdomain satisfaction. On the other hand, longitudinal data also enables accounting for the interconnection between potential changes in domain satisfaction and life satisfaction over a longer period of time.

Finally, future studies should account for a wider range of travel-related dimensions including spatial, familial and professional factors and examine them by considering the interactions between household members and their needs, abilities and preferences, which can constrain the use of a preferred mode, and thereby affect travel satisfaction. Doing so, insights can be gained on the causes, dimensions and consequences of travel-related choice dissonance and dissatisfaction. In this regard, more qualitative studies that apply in-depth interviews with all household members could also provide valuable information.

6.5. Conclusion remarks

With the growing awareness regarding the over-use of fossil fuels and greenhouse gas emissions, population health and socioeconomic exclusion, the idea of a behavioral shift from excessive car use to sustainable transportation, is gaining attraction among both researchers and policy makers, planners and engineers. In line with all attempts that motivate this sustainable behavioral shift, the study of the mobility impacts of involuntary workplace relocation, too, has a prominent added value. This research is theoretically motivated by the notion that key events in life, particularly uprooting and moving to another geographical context, make changes to stable travel-related possibilities, needs and preferences and cause existing habitual coping skills to become ineffective for many individuals. As a result, attentiveness to alternative transport modes will increase, thus, a higher probability of a conscious (re)consideration of current travel behaviour and a change is expected. From a policy planning perspective, these moments are highly valuable as they open up a “window of opportunity” for introducing and encouraging the use of sustainable transportation alternatives and for promoting health and environmental concerns. In this context, it is essential that transport planning is considered together with decision-making and behavioural understanding of individuals whose satisfaction and subjective well-being is – alongside with the sustainability – a first priority that cannot be accomplished solely by expanding and improving transport infrastructures.

Overall, this dissertation contributes to both research and practice, by contributing to knowledge gaps in travel and particularly commuting behavior literature specific to mobility biographies, while also producing methodologies that can be applied by future researchers as well as planning professionals with the goal of improving the practice of analyzing mobility choices and satisfaction data and developing strategies to satisfy travelers and guide mobility towards a more sustainable future.

Appendix I: Information and Consent Form

Logic, arbitration and choice of household mobility in metropolitan territory. An investigation into a strategic relocation of more than 10,000 workers in Montreal

Who runs this project?
I, _____ _____, am a PhD student at the University of Montreal at the School of Urban Planning and Landscape Architecture. My research director, Sébastien Lord who directs this research is a professor at the School of Urban Planning and Landscape Architecture.

Describe this project
This research aims to analyze the impact of the MUHC's relocation on employees' travel habits. The aim is to compare their mobility before and after the move, especially commuting. In this research, we want to better understand how families modify their daily commuting routines and what choices are perceived as possible or not according to their constraints and obligations.

If I participate, what will I have to do?
As an employee of the MUHC _____, your participation in the research will take the form of an interview of about 60 minutes with me. During this interview, you will be asked to talk about your reactions to the relocation of the MUHC and the impact of the relocation of the hospital on your everyday life. This interview will take place according to your choice at _____, on _____ / _____ / _____. The interview will be recorded in audio format for transcription purposes and the places discussed will be placed on a map.

Are there any risks or benefits to participating in this research?
You will contribute to the advancement of knowledge about city planning and household mobility, including what makes it easier to move around the city and what are some of the barriers and difficulties experienced on a daily basis. Little inconvenience is to be expected, even if the research plans to address certain situations that may be problematic because they disturb the daily life of a family (such as family-work arbitration, the choice to move, a change of school for children, etc.). The results of this research will be used to inform thinking about urban transport and housing policies.

What will you do with my answers?
I will analyze all the answers that all participants have given me to better understand how families make their mobility choices on a daily basis and how they come to prefer different ways of getting around the city. The results will be part of my doctoral thesis.

Will my personal data be protected?
Yes! Any information you provide to us in connection with this research (interview data, personal information or your views on the topics covered) will remain confidential. The interviews will be transcribed and the recordings will be destroyed 7 years after the end of the project. After this date, only data that can not be used to identify you will be kept. No name or initial will be associated with the data you provide us, identification codes will be used to ensure your anonymity. Only the researcher responsible for the project will have access to the coding table allowing the participants to be associated with their answers. The recordings of the interviews, the transcripts of the interviews

and the maps that will be produced with the places discussed will be kept in a locked binder located in a closed office. No information that will identify you in any way will be released. We will prepare a summary of the main results that we will send you at the end of our work. If you wish to obtain the final publications of the research, we invite you to enter your email address at the end of the form.

Do I have to answer all the questions and go all the way?
No! Your participation is entirely voluntary. You are free to withdraw at any time by simple verbal notice, without prejudice and without having to justify your decision. If you decide to withdraw from the research, you may contact the Research Director at the telephone number listed below. If you withdraw from the research, all information collected at the time of your withdrawal (residency, transcripts and registrations) will be destroyed.

Who can I talk to if I have questions during the study?
If you have any questions, you can contact my director at 514-343-7215 or at sebastien.lord@umontreal.ca. Several resources are at your disposal.

This project has been approved by the Multi-Faculty Research Ethics Committee of the Université de Montréal. For any concerns about your rights or about the researchers' responsibilities regarding your participation in this project, you can contact the committee by phone at 514 343-6111 ext. 1896 or by email at CPER@umontreal.ca or consult the website : http://search.umontreal.ca/participants .

If you have any complaints about your participation in this research, you can contact the ombudsman (it's a "protector of citizens") at the Université de Montréal, at 514-343-2100 or at email address ombudsman@umontreal.ca (the Ombudsman accepts collect calls).

How can I agree to participate in the study?
By signing this consent form and giving it to me. I will leave you a copy of the form that you can keep for future reference.

CONSENT

Participant statement
• I understand that I can take my time to think before agreeing or not to participate.
• I can ask questions to the research team and demand satisfactory answers.
• I understand that by participating in this research project, I do not waive any of my rights or release researchers from their responsibilities.
• I have read this information and consent form and agree to participate in the research project.

I consent to the recording of the interview: Yes _____ No _____

I would like to receive the research publications at the following address:
_____

Signature of the participant: _____ Date:
_____

Last name First Name: _____

Engagement of the student researcher
I explained the conditions of participation in the research project to the participant. I responded to the best of my knowledge to the questions asked and made sure of the participant's understanding. I commit myself, along with the research team, to respect what has been agreed to in this information and consent form.

Signature of the student researcher: _____ Date:
_____

Last name First Name: _____

Appendix II: Quantitative Survey Questions

Language: English

Welcome to an important survey for the MUHC/RI-MUHC

The MUHC, in collaboration with Université de Montréal, Polytechnique Montréal, Concordia and McGill are asking for your participation in a short survey on your commuting habits. The survey will contribute to a better understanding of your needs and is required for LEED-EB certification of the Glen site. LEED-EB stands for Leadership in Energy and Environmental Design in Existing Buildings — an international green building rating system.

The more people who participate, the more complete a picture we will have. We thank you in advance for answering the five questions below.

L0100 **Did you work at the Glen site at any time during the previous week (Monday, May 7 to Sunday, May 13, 2018)?**

- ○ Yes
- ○ No

L0500

You completed the first module of LEED mobility survey!

Continue the survey and help us to understand the challenges of changing your commute to the Glen site.

This is a major issue in Montreal for which you would help us make essential recommendations to:

- **Transportation agencies** for mobility services to the Glen site
- **City of Montreal** to improve amenities in neighborhoods near the Glen site
- **MUHC / RI-MUHC** to support services and support to employees

Click and participate in the following parts of the survey to get the chance to win 5 prizes of $100!!!

(Netflix, Best Buy, Ares Cuisine, Fermes Lufa, Choice Hotels)

Understanding the consequences of relocation of the MUHC to the Glen site

The team and the research project

An inter-disciplinary research group from Université de Montréal, Polytechnique, McGill University, and Concordia University is currently undertaking a research project aiming to assess the impacts of the MUHC's relocation to the Glen site on employee travel patterns. The objective is to compare their mobility before and after the move, especially daily travel to work. This project is funded by Social Sciences and Humanities Research Council of Canada (SSHRC). The team is working under the supervision of Sébastien Lord, Professor at the School of Urban Planning and Landscape Architecture, Faculty of Planning, University of Montreal.

Your participation in the research

You are invited to participate in this survey. It will take you 15 to 20 minutes to complete the online questionnaire. By clicking on the "**I agree to participate**" button, you consent to participate in our study. You participation is voluntary. **You can leave the survey and pick up where you left afterwards**; if so, please make sure to click on the "*finish later*" button (top right of your screen) to save your answers. Please note that even half-completed surveys can be used for analysis purposes.

Thereafter, if you are interested, we would like to meet with you as an MUHC / RI-MUHC employee for a personal interview in the months following the survey. You can click on the "**I accept to be contacted for an interview**" button. If so, we invite you to include your email and/or a phone number to reach you. Therefore, with a bit of your time, you would help us document the challenges of family mobility in Montreal, and make recommendations to develop more efficient mobility solutions or even encourage sustainable transportation in Montreal. Your participation is greatly appreciated.

Win prizes!

This questionnaire contains 4 separate modules. By giving their e-mail address, all participants have an equal chance to win a prize in each of the modules. These prizes are selected in consultation with MUHC management and come from corporate partners.

Guarantee of confidentiality

The data collected in this questionnaire are strictly confidential and will be destroyed 7 years after the end of the project. To avoid duplicate answers, your IP address is registered when you participate but will not be used for any other purposes. Survey responses will be stored on a password-protected computer and participants will not be identified in any publications or reports. We guarantee the confidentiality of the answers.

Right of withdrawal

Your participation in this project is entirely voluntary. However, you will not be able to withdraw from the research project once you have completed the questionnaire. Indeed, in order to ensure confidentiality, no information allowing us to associate the identity of the participants with the completed questionnaires is collected.

For further information

You can reach the project manager at 514-343-7215 or via sebastien.lord@umontreal.ca (mailto:sebastien.lord@umontreal.ca). This project has been approved by the multidisciplinary committee on research ethics of the Université de Montréal. If you have any concerns about your rights or the responsibilities of researchers regarding your participation to this project, you can contact the committee at 514-343-6111, post 1896 or via CPER@umontreal.ca (mailto:CPER@umontreal.ca), or check the website: http://recherche.umontreal.ca/participants (http://recherche.umontreal.ca/participants). If you have a complaint about your participation in this research, you can communicate with the ombudsman, ("citizens' protector") of the University of Montreal, at 514-343-2100, or via ombudsman@umontreal.ca (mailto:ombudsman@umontreal.ca) (collect calls accepted).

Click here if you want to print this consent form and the coordinates it contains

I0000**Your consent to participate:**

You need to agree to participate in order to continue

☐ I agree to participate to the research

☐ I accept to be contacted for an interview

Context of work and residence

For the following questions, we are interested in your occupational status and living situation.

I0110 **Since when have you been working at the Glen site ?**

Month / Year

I0100 **Since when have you been working for the McGill University Health Centre (MUHC / RI-MUHC) ?**

Month / Year

I0200 **What is your position at MUHC / RI-MUHC?**

Currently, I work as a

I0500 **Is the schedule you indicated for last week (May 7th to May 13th, 2018) your usual work schedule?**

○ Yes
○ No

I0600 **Did your work schedule change after relocation to the Glen site?**

- ○ Yes
- ○ No

I0700 **Do you work elsewhere than the Glen site?**

- ○ Yes
- ○ No

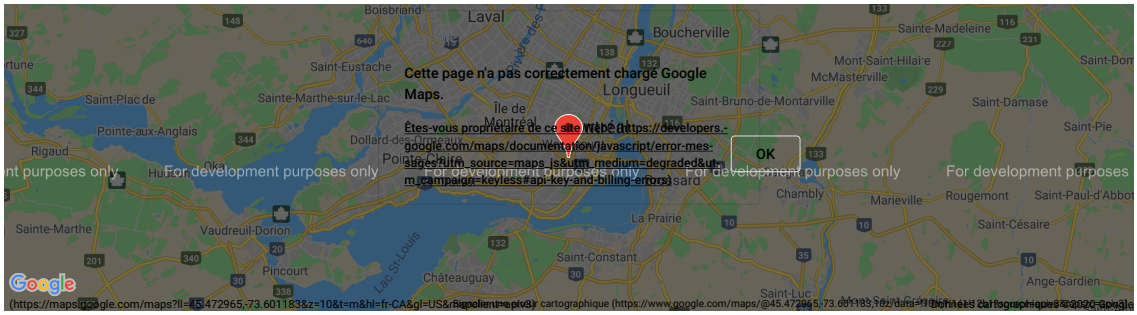
I0800 **Describe the following elements, related to the Glen site:**

Please do not forget to answer two questions in each row.

	What is the degree of your satisfaction with each of the following elements?					Has there been an improvement compared to your former workplace?		
	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied	Yes	No	Not applicable
Accessibility to public transportation	○	○	○	○	○	○	○	○
Distance between work and your current home	○	○	○	○	○	○	○	○
Accessibility to paid parking	○	○	○	○	○	○	○	○
Availability of amenities on Glen site (gym, restaurants, etc.)	○	○	○	○	○	○	○	○
Proximity to services amenities offsite (bank, gym, etc.)	○	○	○	○	○	○	○	○

I1000**What is your current home location ?**

On the following map, please adjust the zoom and drag the pin to the desired location.



I1100**Since when have you lived at your current home location ?**

Month / Year

I1200**Do you plan to move because of the relocation of your job to the Glen site?**

Please choose...

I1400**What is the typical length of your daily travel to work ?**

	From home to work	From work to home
Current home location to the Glen site on a typical day	...	...

Changing in your typical daily travels

For the following questions, we are interested in comparing your typical commute trips before and after the relocation of your job on the Glen site. Think about one of your typical travels to and from work before and after the relocation and answer the following questions.

II1500**Overall, how satisfied were / are you with your typical daily commute ?**

	Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied
Before the relocation to the Glen site	○	○	○	○	○
After the relocation to the Glen site	○	○	○	○	○

II1700**We are interested in the different travel sequences you take to commute between the Glen site and your current home location.**

Here are some examples of sequences of modes:

HOME — Car — **WORK**

HOME — Bus — Metro — Bus — **WORK**

II1710**What is the most frequently used travel sequence to get to the Glen site:**

You can indicate between 1 and 5 modes of transportation. The order of use of each of these modes is important. Do not include walking periods of less than 5 minutes.

HOME — **WORK**

Mode 1 Please choose...

II1800**Do you sometimes use a different travel sequence to get to the Glen site?**

- Yes
- No

II1900**Before relocation of your job to the Glen site, did you use the same travel sequence as currently?**

- Yes
- No

II2000**With regards to your daily commute to the Glen site, how much you agree with the following statements?**

I use this / these mode(s) of transportation because:

	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Not applicable
I want to reduce my environmental impact	○	○	○	○	○	○
This choice is economically affordable for me	○	○	○	○	○	○
This choice is good for my health	○	○	○	○	○	○
I need to stop at other places on the way	○	○	○	○	○	○
I have no other choice	○	○	○	○	○	○

Travel habits and preferences

We are interested in your use of different modes of transportation as well as the cost of your daily trips before and after the relocation of your job on the Glen site.

III2300**What do you think of each transportation mode, even if you do not use it?**

For each transportation mode, **opposing qualifications** are provided. For each pair of qualifiers, check the box that best matches your opinion.

III2310

Bus

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2320

Métro

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2330

Train

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2340

Car

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2350

Bike

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2360

Walk

	Strongly agree	Agree	Neutral	Agree	Strongly agree	
Fast	○	○	○	○	○	**Slow**
Expensive	○	○	○	○	○	**Cheap**
Ecological	○	○	○	○	○	**Polluting**
Uncomfortable	○	○	○	○	○	**Comfortable**
Dangerous	○	○	○	○	○	**Secure**
Tiring	○	○	○	○	○	**Relaxing**
Reliable	○	○	○	○	○	**Unreliable**

III2400**How many automibile(s) in total do / did you have in your household including yours?**

Before the relocation to the Glen site	After the relocation to the Glen site
...	...

III2520**In your opinion, finding a parking space at**

Your former workplace or its vicinity	The Glen site or its vicinity
Please choose...	Please choose...

III2800**Comparing the cost of your current daily travel to work to that of before relocation to the Glen site, your travel cost is:**

Considerably increased	Somewhat increased	The same as before	Somewhat decreased	Considerably decreased
○	○	○	○	○

IIICADEAU

You've completed the third part!

To have the opportunity to win a **$100 gift certificate at *Ares: Kitchen Accessories***, insert your mail adress:

Residential situation

For the following questions, we are interested in comparing the characteristics of your home before and after your relocation of your job on the Glen site. The word “home” refers to a house, an apartment or a rented room. If you have more than one home, consider the one where you spend the most time during the week.

IV2900**What type of building describe your current home?**

Please choose...

IV3000**In relation to your current home, you are:**

IV3300**Taking all things into account, how satisfied are you with your life these days?**

Very satisfied	Satisfied	Neutral	Unsatisfied	Very unsatisfied	I prefer not to answer
○	○	○	○	○	○

IV3400**What is the occupation of the other members of your household ?**

Fill in according to the number of people in your household

Leave blank if your household is composed only of you

Member of the household	Occupation
Please choose...	Please choose...

IV3500**Indicate the following information regarding the other member(s) of your household :**

At the least, provide information about yourself

	Year of birth	Gender
Yourself	Please choose...	Please choose...

IV3600**Which other member(s) of your household own(s) a driver's license**

- [ ] Yourself

IV3800**What is the yearly income of your entire household (including yourself) in CAD $?**

Please choose...

IV3900**What is the highest level of education that you have completed?**

Please choose...

IV4000**What is your country of birth?**

IVCADEAU

You've completed the survey! Thank you for your precious time!

To have the opportunity to win a **$100 gift certificate at *Netflix***, insert your mail adress:

VFin**Participate in a personnalized interview**

We would like to meet concerned people for a personal interview in the next month. This interview will allow us to deepen some of the issues raised by the MUHC relocation. To participate, click on the "**I accept to be contacted for an interview**" button. We invite you to provide us with email adress and/or phone number to contact you. With a bit of your time, you can help us better understand the challenges of family mobility in Montreal and make recommendations to develop more efficient mobility solutions, or even encourage sustainable transportation in Montreal. Your participation is greatly appreciated.

By signing up, you receive the opportunity to win a **$100 gift certificate at *Choice Hotel Canada***.

☐ **I accept to be contacted for an interview**

Appendix III: Qualitative Survey Questions

To begin the discussion:

Here is the interview process:
According to the data collected in the online survey, we will trace the thread of several events. There is no right or wrong answers. We are interested in your experiences in life and your reactions towards them.
In this regard, we will ask you questions about the places you visit regularly and the times you travel to work and elsewhere in the city.
As mentioned in the contest form that we have just seen together, we will record the interview to facilitate the information analysis process.

1. How would you describe your daily situation from the perspective of your family?

- How are daily travels organized usually in your home?
- Do you talk about them frequently?

- In general, how and who does decide about the modes of transportation of the household?
- What are these modes and who takes what? Who is responsible for them? (Who pays for and take care of the costs?)

- Do you know how much is the cost of your transportation (in money and time)?
- Is that a lot for you?

- How do you organize your work-family balance?

To continue the interview:

We will come back to your travels of the last few days to understand your choices of destination and your transport constraints.

Part I

Daily travel destinations and constraints

[Following previous week's travels]

2. Is this travel week representative of your usual routine?

- Is this routine the same in all seasons?

- In winter?
- In summer?

- Was it different before the relocation of the MUHC? Why do you say that?

3. We now have questions about the routine of travel.

- How do members of your household organize a typical day?
- If you work: Do you have a regular schedule? How many hours do you work per week? Per day? How many days do you work per week? What are your working hours? Where is your place of work in relation to your home?
- Why did you choose these places (home, work, schools, nurseries, etc.)? What were the reasons, but also the constraints?
- What are the other highlights of your schedule? E.g., personal activities (domestic, cultural, sports, associative, political, etc.), school schedules of children, etc.?

- What were the differences in your routines before the relocation of the MUHC?

4. We continue with questions about the planning and conduct of the journeys.

- Who goes where?
- How do you choose the route? Do you generally plan for your travel? How do you do it?
- How do you choose the mode of transport?
- How do you find the duration of these trips? (Short or long?)
- How do you feel when you are on these trips? (Is it pleasant or unpleasant?)
- What does influence the length of your journeys? (Presence of a child, shopping, additional destinations, time of departure, etc.)

- Did the relocation of the MUHC make your journeys more complicated? How?
- Have you tried different ways to get to the new MUHC site?

- Do you think if there is a mismatch between your place of residence and place of work vis-à-vis transportation services? (e.g., your home location does not support transportation modes which are available at the new MUHC or vice versa.)

- What do you think of having access to activity opportunities (shopping, bank, gym, etc.) near your workplace? Or, on the way from work to home? If you have these accessibilities, would you use it? How often?

- Are you satisfied with the new MUHC site with respect to these accessibilities?

- When you were informed that the hospital will relocate, did you happen to travel to the new site to see how your travel to work would be after the move?
- Did you happen to gather information about transportation opportunities at the new site?

- What were the advantages of anticipation of the MUHC's relocation vis-à-vis your daily transportation?

To continue the interview:

We will now discuss your use of technologies in your daily commutes, particularly regarding your choices of destination and travel constraints.

Part II

Use of smart city "technologies" and the effect of these uses on time

5. Do you use digital devices before and while traveling?

- If so, what changes does it bring to your routines? Does it save you time?

- Have these technologies helped you adapt your routines to the new MUHC?

- Do you know the various technological elements that the city has put in place to facilitate your travels in the city? (E.g., applications to find out if there is a free bike station, screens to know the waiting time for the next metro, the possibility of paying parking via its telephone, etc.)
- Do you ever use such services? For what purposes? Are you comfortable with these services?
- What do these services provide for you? Do you think they are saving you time, wasting time or having no consequences in terms of time?
- If they save you time, what do you do with the time that these technologies give off?
- Does using technological tools make you change activity places? Are you suggesting new ones? (E.g., Yellow Pages, Yellow Pages for last minute restaurant, boutique, etc.)

- Did you or any of your household members use any of these technological tools before the relocation of the MUHC to predict transportation-related changes associated with the relocation?
- If so, what tool(s) did you use?
- Did you find the information you received from those tools correct and practical after the move? How much was that anticipation and being proactive helpful after the move?
- Do you think if the MUHC provided better services regarding transportation possibilities and constraints of the new site, you would have considered using other transport modes?
- In comparison with public technological tools and apps, do you think an inter-organization technological tool for transportation (customized only for MUHC employees) would encourage you more to change your current mode to a more sustainable one? (e.g., if the person drives car switch to public transport, if the person use public transport, switch to active modes)

- If not, why? (e.g., because your work/activity/travel schedules are not compatible with other transport modes? Or, generally, you are not a flexible person? Etc.)

To continue the interview:

We will now discuss the choice of places in your daily life (residence, work, other) in time, with special attention if you have moved your residence or influenced by the change of workplace.

Part III

Dynamics of choice of places and relationships to time

6. Do you feel that your travel habits have changed since the relocation of the MUHC?

- If yes, why?
- During the five years prior to the relocation of the MUHC, did your transportation patterns change? If yes, why?

- [If change of residence] what were your criteria for the change?
- [If change of workplace] what adjustments did you make?
- [Other changes?] (Partner's job, school/daycare of kids, etc.)

To continue the interview:

We will now discuss some of your personal characteristics such as attitudes and habits in your decision-making process regarding residential choice, daily travels, mobility tool ownership, and other familial events.

Part IV

Mobility biographies and decision-making process

7. Have you experienced any familial life events during the last five years? (E.g., marriage, divorce, a child leaving the household or obtaining a driver's licence, birth of a child, death of a family member, etc.)

- If yes, when?
- How did that event influence your decisions for residential location, daily travel patterns, and mobility-tool-ownership decisions?
- What did you do when anticipating the event(s)? Where you proactive or reactive in the process of decision-making?

- In general, are you a proactive or reactive decision-maker?

- In general, do you tend to follow your habits in daily activities (particularly travels) or you consider yourself as a weak habit individual?

- How did this personal characteristic affect your (residential, car ownership, travel-related) decisions during the period of the relocation of the MUHC?

- Do you concern about your environmental impacts?
- Do you mind breaking your habits and routines and change toward more sustainability? Particularly towards use of green transport modes, even if you need to reduce your car use or increase physical activity or use of public transit?
- Will you be interested in relevant informational campaigns?

To finish the discussion:

End of the interview.

We will conclude the interview by discussing your vision on possible solutions and alternatives for an "ideal" mobility, according to your tastes and preferences.

Part V

Solutions and alternatives for an "ideal" daily mobility

8. What would be an "ideal mobility" in your opinion?

- How would you spend your time in transport ideally?

- In terms of distance, time, places to visit?

- Is the relocation of the MUHC ultimately a success for you and your household? Why do you say that?

9. Do you want to add anything else?

10. Do you have any questions about the conduct of the research?

Thank you so much for your time.

Appendix IV: The Impacts of Residential Relocation on Commute Habits: A Qualitative Perspective on Households' Mobility Behaviors and Strategies

Abstract

Travel-behavior researchers have generally acknowledged the important role of life events in disruption of habits and increasing individuals' tendency to re-evaluate their travel behavior. Research in this area is dominated by the use of quantitative research methods, leading to a gap in understanding of the complexity of subjective factors such as habit strength and the reasons underlying resistance to change. In this study, with a retrospective and qualitative approach, 20 individuals who have relocated their home recently are questioned about factors which affected their commute mode choice before and after the relocation. First, participants were categorized based on the commute mode they used before the relocation to assess habit strengths across modes. Second, participants were presented with a set of green-transport-encouraging policies and evaluated on the extent to which they were willing to adopt these policies based on their habit strength. Accordingly, different typologies of individuals were identified. The levels of travel habit strength were found to be directly related to the willingness to change; strong habits, whether *good* or *bad*, are unlikely to change even in the wake of a major life event. By focusing on the habit formation and decay during the period of relocation, this study evaluates travel-related decision-making as a process in an effort to understand how and when sustainable-transportation policies should be promoted for different types of individuals in situations where attentiveness for alternative travel modes is increased. This study on residential relocation informs considerations of changes in travel behavior related to other contextual changes.

Keywords: Habit strength; Commute mode choice; Sustainable travel behavior; Residential relocation; Planning policy

1. Introduction

During the past few decades, life-course and biography approaches have garnered considerable attention in the field of transportation research (Busch-Geertsema & Lanzendorf, 2017; Chatterjee

& Scheiner, 2015; Müggenburg et al., 2015; Scheiner & Holz-Rau, 2013b; Zhang, 2017). According to mobility biographies, during a life course, different familial key events such as the birth of a child or professional events such as workplace relocation can trigger the need for mobility rearrangement by changing possibilities, needs, preferences and abilities (Lanzendorf, 2003; Müggenburg et al., 2015; Scheiner, 2007). Despite the broad range of objective and subjective factors affecting individual's travel-related decision making, daily mode choice is greatly influenced by habits. Habits, among all subjective factors, seem to be more likely to dominate travel behaviors, especially daily home-work trips (Klöckner & Matthies, 2004; Rasouli & Timmermans, 2015; Verplanken et al., 2008). Residential relocation is one other significant key event that triggers changes in daily commute habits (Clark, Chatterjee, et al., 2016a, 2016b). It is suggested that when the location of home as one of the main behavioral contexts in an everyday home-work travel changes the routinized actions possibly deliver lower degrees of utility and satisfaction. In this context, attentiveness for alternative solutions increases and a "window of opportunity" opens up for behavioral change, hence, interventions will be more effective (Franke, 2001; Müggenburg et al., 2015; Stanbridge et al., 2004; Verplanken et al., 2008). It is therefore important to study residential relocation from various perspectives to fulfill the aim of understanding the sustainable transportation opportunities that lies behind such key events in life. Although residential relocation is one of the best researched key events for travel behavior (Bamberg, Rolle, & Weber, 2003; Krizek, 2003; Prillwitz et al., 2007; Stanbridge et al., 2004), few qualitative studies exist on this topic concerning the different types and patterns of commute habit changes and how these changes related to residential relocation. In addition, considering the significance of commuting journeys in the literature of travel behaviour and mobility biographies (Zarabi & Lord, 2019), it is worth assessing this particular habitual behavior from different perspectives to provide in-depth insights into the process of habit formation and decay. Evidence shows that commuting behaviour is either performed consciously or unconsciously, and habitually or intentionally depending on one's level of habit strength. In this context, it is relevant to evaluate habit strength and weakness when studying daily commuting behavior.

The main objective of this paper is to assess the impact of one specific voluntary life changing event, the relocation of home, on households' commuting behavior. Using data from 20 interviews with individuals who have recently moved home, we evaluate the travel-related decision-making process around the period of relocation. By focusing on the commute modes used before and after

the move, we identify different typologies of individuals vis-a-vis travel habit strength and mode choice. A set of planning policies that encourage and promote the use of low carbon transportation modes were also presented to the interviewees in order to assess the relationship between the habit strength and the willingness to adopt sustainable transport alternatives.

The remainder of this paper is organized into four parts. Section 2 presents a literature review on the concept of habit in mobility biographies. Section 3 describes the methodology used to conduct the qualitative interviews. Section 4 presents the findings: first by discussing the residential relocation as a process in which commute habits are likely to be disrupted and reconfigured again; second by categorizing the participants into three groups based on the commute modes they use before the move; third by categorizing the participants based on their habit strength and willingness to adopt green transportation strategies. Next, the paper discusses key findings and makes recommendations for encouraging sustainable travel behavior (Section 5). In conclusion, suggestions for future research are provided (Section 6).

2. Theoretical background

The Theory of Planned Behaviour (TPB) (Ajzen, 1991) and the Normative Decision Making (NDM) (S. H. Schwartz & Howard, 1981) theory are among the most common theories that have been used to explain the barriers of behavioral change from a socio-psychological perspective. These models try to describe decision making as a multistage process with a logical order in which a stimulus provokes the decision-maker to start to assess the problem (attention stage) and then builds up motivation for action (Schönfelder & Axhausen, 2010). After evaluating the potential consequences of behavior, if assessment is positive, the behavior is invoked. Psychologists argue that habitual behaviors often conflict with this process in a sense that the emergence of a stimulus automatically provokes the routinized actions. Habits lead the decision maker to bypass the problem evaluation, motivation build-up and assessing the behavior consequences stages. Studies have identified three main reasons for individual's attachment to habits: 1) Seeking for and constructing new alternatives is costly and time-consuming; 2) Expected benefits of alternatives are too uncertain; 3) Repetition of past solutions is more efficient, i.e., easier and less risky (Gärling & Axhausen, 2003; Schönfelder & Axhausen, 2010). Therefore, habits and daily routines are suggested to be as one of the obstacles for behavioral change and the reason for remaining on "nonoptimal" choices with regards to spending time, cost or energy.

The mobility biography and the habit discontinuity approaches presume that context changes (Verplanken et al., 2008), turning points (Beige & Axhausen, 2012), life course/key events (Klöckner & Matthies, 2004; Lanzendorf, 2010; Prillwitz et al., 2007; Scheiner, 2007) or discontunities (Verplanken & Roy, 2016) make changes to stable situations and cause the habitual coping skills to become ineffective. As a result, the sensivity to new information and opportunities regarding the alternatives will increase. It is in this context that people are more likely to conciously consider their motives and values, evaluate the consequences of their actions and make more intentional decisions. However, shortly after adapting to the new situation, habits gradually become more important in guiding behavior than rational deliberation.

In order to explain the process of habit disruption and reformation after the occurrence of a life event, Klöckner (2004) develops a conceptual model. He presents four levels of habitualization, activation, information seeking and deliberateness for a well learned behavior and discusses how a life event influences these levels (see Klöckner, 2004). This model, however, does not take into account two elements of travel behaviors. First, the model does not distinguish between **voluntary** and **involuntary** events such as a planned home relocation compared to a forced home relocation (e.g., gentrification or neighborhood redevelopment) or an involuntary workplace relocation as in organizational mergers. For example, an involuntary workplace relocation can happen when one or multiple job organization(s), at one or multiple location(s), move or merge (in)to another location. From the standpoint of the employees, this relocation is an exogenous life event that can influence their commuting whereas they have very little part in initiating or controlling the move (Zarabi & Lord, 2019).

It is still unclear to what extent the processes involved in a particular voluntary event in life such as home relocation can translate to other events especially the forced ones. It is suggested that during the process of a home relocation, individuals are more likely to have a reasonable degree of control over when and where they relocate compared to a relocation that is forced by an employer or is a result of an urban gentrification (Walker et al., 2015). According to Thomas et al. (2014), autonomy, control, and perceived trust in leadership are among the important issues that arise during the process of a relocation (whether forced or voluntary) and can influence commuters and their travel-related decisions. Day and Cervero (2010) found that some urban residents who were forced out by government reclamation of their residences were significantly affected in terms of job accessibility and commute time relative to those who moved by choice.

Second, Klöckner's model does not include variation of behavior change related to different levels of **habit strength**. Individuals with different levels of flexibility may behave differently in face of a changing situation. Habitualization has different levels of complexity, as habits can be strong, moderate or weak. In an investigation of information seeking, Verplanken, Aarts, and Van Knippenberg (1997) found that participants with strong habit of car use or cycling were less likely to gather information about alternative travel modes compared to weak habit individuals. Furthermore, those participants with strong habits who did a search, sought out for information that was congenial and supported continued habit performance, whereas this tendency was less evident for those with weaker habits. Betsch, Haberstroh, Glöckner, Haar, and Fiedler (2001) also reported that in a stable behavioral context participants with strong habits searched for information about the habitual travel mode option itself rather than about alternative options that might challenge the routines (Verplanken & Wood, 2006). In another study, Verplanken, Aarts, van Knippenberg, and Moonen (1998) revealed that when commuting habits are weak or had not been formed (before an event), individuals act on their intentions, and those who intend to use a particular mode do so more often. However, when commuting habits are strong, intentions have little effect on behaviour thus travel behavior is continued to be signaled by performance context irrespective of intention.

Based on the foregoing discussions, we hypothesize that commuters with strong habit of using a particular mode are less likely to change their travel behavior as opposed to weak habit commuters when experiencing a significant life event like residential relocation (Busch-Geertsema & Lanzendorf, 2017). Therefore, communication and marketing efforts for travel-mode changes are more likely to be influential if they target home movers with weak travel habits.

3. Methodology

Much travel behavior research relies more on quantitative modelling and finding statistical correlations between relevant factors than on discovering the complex causal relationships and the interactions between a key life event and travel behavior. The use of qualitative methods that allow for in-depth evaluation of relevant factors affecting the travel-related decision-making process are still limited compared to quantitative techniques. Qualitative approaches can provide detailed insight into the experiences of travel habit formation and decay. Strategies to promote sustainable commuting require depth and breadth of understanding individuals' motivations for beginning and

maintaining public and active mode use, which qualitative methods are suited to exploring (Ogilvie & Jones, 2012). In fact, qualitative studies can be used for exploring and developing new hypothesis to be tested in quantitative analysis. Although face-to-face interviews do not provide datasets as generalizable as those from quantitative surveys, they have other advantages such as the greater efficiency of data collection and reduced risk of misunderstanding or self-presentation biases associated with quantitative surveys (Lanzendorf, 2010; Thomas et al., 2014).

This study was completed through conducting face-to-face interviews. Since the study is focused on the transportation impacts of home relocation, participants were identified among those who had relocated home during the last two years to ensure adequate recall of the moving. The 2-year period was also chosen under the assumption that it may take such a time frame to develop and establish new travel mode choice habits (Ogilvie & Jones, 2012; Verplanken et al., 2008). In order to approach participants, the study was announced through Twitter, Facebook and email network. A sample of twenty volunteer individuals[19] - included immigrants who have been living in Canada for at least five years - reflecting a specific range of ages, household compositions, work and home locations, travel modes, and including both men and women was selected. The project was announced as a study on household's daily mobility and residential relocation. For this study, ethical approval was granted by the Multi-Faculty Research Ethic Committee at University of Montreal. Written informed consent was also obtained from all participants.

Table 1: Socio-demographic characteristics of the respondents

Characteristics		Cases
Gender	Male	10
	Female	10
Age (years)	25-30 31-35 36-45 > 45	2 5 10 3
Education	Undergraduate degree Master's degree Ph.D. degree	7 7 6
Number of children in household	0 1	12 8

[19] Our sample included eight couples (16 participants) all of whom were wage-earners. In these households, couples were interviewed both separately and together, thus, counted as two participants.

Household type	Single Couple without children Couple with children	2 2 16
Employment status	Full-time	20
Total	Σ	20

Respondents were asked to explain whether their main mode of travel for journey-to-work had changed following the relocation. Table 2 shows the main transportation mode used for the commute both before and after the move. As the table indicates, in the sample of cases analyzed, relocation was predominantly associated with an increase in car use for commute. The reasons underlying this mode shift are explained in section 4.3.

Table 2: Transition matrix showing movements from one mode to another for the commute journey before and after the relocation

	Mode after the move				
Mode before the move	Car	Public transit	Active transport	Total (before)	Number changed mode
Car	6	0	0	6	0
Public transit	4	6	1	11	5
Active transport	1	2	0	3	3
Total (After)	11	8	1	20	8

3.1. Face-to-face interview

The research involved 20 in-depth semi-structured interviews that took place during winter and spring 2018, at the interviewees' home or workplace as preferred. On average, each interview took about 30 minutes. Using retrospective and actual-situation-looking questions, each participant individual elaborated the following elements regarding themselves and their household members:

1) Experiences of and reasons for relocating
2) Priorities in choosing the new home and the underlying rationales
3) Attempts made in searching for travel-related information during the relocation period
4) Changes (or not) in travel/activity patterns specially journey-to-work characteristics
5) Commute habit strength and reasons underlying any change (or not) around the relocation
6) Willingness to change and use of low carbon transportation modes for daily travel

In this study, the interview data was examined by investigating evidence of activation, information seeking and deliberation which are constructs from theory. For the purpose of the interviews' analysis first, two tables containing various sections on the main objectives of the research were

provided (Table 3 and 4). Then, the audio-recorded interviews were listened to and transcribed whenever the responses arose more frequently and were salient to the objectives of the study which were questioned in the tables (Creswell & Poth, 2018; Hay, 2016; Lanzendorf, 2010; Ogilvie & Jones, 2012; Stanbridge et al., 2004). Accordingly, key points were identified and marked at their related section in the corresponding table for each participant. Participants were given pseudonyms.

The first table gathered information regarding the three habit-reconfiguration stages of activation, information seeking, and deliberation during the process of home relocation (Table 3). The second table defined the participant's level of willingness to change of commute habits (Table 4). This table provided the participants with a set of strategies that encourage the use of public and active transport modes and asked them to discuss the extent to which they were willing to adopt each strategy into their daily commute. The policies presented in table 4 are adapted from Sprumont et al. (2014) and Verplanken and Wood (2006). Table 3 and 4 also complement the approach presented in Stanbridge et al. (2004) by providing more detailed insights into the stages of decision-making undertaken as well as policy preferences based on the individuals' habit strength.

In order to identify the strength level of participants' commute habits the interview contained discussions of attitude, subjective norm, behavioral intention and habit strength concerning choosing to take the car, public or active transport mainly for commute but also to other destinations than work. With regards to the attitude towards the most frequently-used commute mode, the interview questions included four attitudinal elements: costs, reliability, convenience and speed. For each item the respondents were asked to elaborate the importance of the element for their mode choice for commute. Subjective norm was also evaluated based on the extent to which one prioritizes reducing environmental impacts over personal benefits. Behavioral intention was assessed by asking respondents to discuss to what extent they intended to choose the most frequently used commute mode for their daily trip to work. As for the evaluation of habit strength we were inspired by a combination of three different approaches. First, the self-reported frequency of past behaviour, which is traditionally used as an operationalization of habit (Ouellette & Wood, 1998). Respondents were asked how frequently (never; rarely; sometimes; often) they took each mode for their daily commute. Second, respondents were presented with five conditions that are known to influence mode choice for work trips (weather conditions; having to complete after-work errands; traffic or delays in roads or public transit due to construction or maintenance; working

hours and level of punctuality required; travel costs). They were asked to indicate as quickly as possible what travel mode they would choose in each situation. It was assumed that the most invariant participants' responses were (i.e., concerning choosing a particular mode) the stronger the habit concerning choosing that option. This measure, called the response-frequency measure of habit strength, has been validated in a number of earlier studies (e.g. Busch-Geertsema & Lanzendorf, 2017) albeit with a slight difference. In these studies, instead of the above-mentioned conditions, respondents were presented with hypothetical trips and asked to indicate what travel mode they would choose in each situation. Third, we administered a short form of the Self-Report Habit Index (SRHI) method (Verplanken & Orbell, 2003) focused on the most frequently-used mode for commuting. This comprised four questions concerning the automaticity and lack of awareness feature of the behaviour: "Commuting by X is something that … 'I do automatically', 'I do without thinking', 'I start doing before I realize it', and 'I do without having to consciously remember'" (Gardner, Abraham, Lally, & de Bruijn, 2012). However, instead of asking the respondents to rate each item on a Likert-type scale, we asked them to verbally discuss the extent to which they agree or disagree with each item. Our assumption was the more habitual the commute choice is, the more items one would strongly agree with. The proportion of these responses thus served as our measure of habit strength.

Reconfiguration of daily travel routines during the period of home relocation consists of three major stages; activation; information seeking; and deliberation. For each stage, participants were presented with several events/actions that they might have faced/performed in anticipation of or adaptation to the home relocation. For the activation stage or the relocation stimuli, participants were asked to explain their reasons for relocation and the interplay between them. For the second stage, participants were questioned whether they sought information regarding the new home, its neighborhood, activity opportunities and travel options around it, etc. and whether they did their search before or after the relocation. Finally, the deliberation stage asked for the transportation-related actions that each participant took either before or after the relocation.

Table 3 (used during the interviews): Sample of a table completed for one participant concerning the habit reconfiguration stages during the relocation process

Habit reconfiguration stages	Time occurred / performed	Events occurred or actions performed in anticipation of or in adaptation to the event

Activation (stimuli)		Need of larger living space or lot	Need of better accessibility (to job, school of kids, etc.)	Preference for a different neighborhood (more dynamic, quiet, etc.)	Experiencing / expecting other life events (birth of a child, marriage, graduation, etc.)	A release from budget constraints	Purchasing residential property as an investment
		•	•		•	•	•
Sarah, age 31:	*"We were expecting a baby nine months before the move. At first, we decided to rent a bigger apartment in our previous neighborhood. But, after two months my spouse found a permanent job and we became eligible to get a loan from bank to purchase a property. … We looked for residential properties around my spouse's workplace … We were concerned about accessibility to work and amenities."*						
	Before	•	•		•	•	•
	After						
Information seeking		Using technological tools, internet and application to gather information	Talking to others (real estate agents, residents of the new location, friends and family, etc.)	Rehearsing the new journey	Building up imaginations based on the previous experiences of the new location	Traveling to the new location just to see the neighborhood, etc.	
Sarah, age 31:	*"Before the move, in order to find out the latest residential properties posted, we used one application called centris.ca installed on our cell-phones. We also used Google Maps to evaluate the place regarding accessibility…"*						
	Before	•	•	•		•	
	After	•					
Deliberation		Purchasing / disposing car, PT ticket, bike, etc.	Changing activity spaces (shopping, gym, bank, etc.) or job location	Changing trip chains	Changing travel mode	Changing travel time	
Sarah, age 31:	*"We purchased our car one month before the move. I was in my eighth month of pregnancy and having a car was necessary especially because we got farther from my hospital after the relocation… In our new residence shopping and services were outside of walking distance and were mostly accessible by car only. Our trip chain changed twice. Once after purchasing of the car and once after the move. Same for our travel mode and travel time for commute."*						
	Before	•		•	•	•	
	After		•	•	•	•	

Participants were also asked to discuss the extent to which they were willing to change their travel habits in favor of using more sustainable transportation modes for the journey-to-work. Accordingly, interviewees were presented with a set of strategies that aim at encouraging the use of active and public transport modes and require individuals to involve actively in them (Table 4). Participants were asked to explain whether and at what point around the relocation period each of the policies would have stimulated them.

Table 4 (used during the interviews): Strategies that encourage adopting more sustainable travel behavior

List of policies that encourage the use of sustainable transport modes

1	Participating in informational campaigns
2	Attending workshops about transportation opportunities
3	Reading booklets, flyers, websites, etc. about green transportation opportunities
4	Accepting to use a subsidy for public transit
5	Ridesharing with colleagues for traveling to work
6	Joining carpooling network using a mobile application
7	Lightly staggering work hours
8	Working from home

4. Findings

This section presents an analysis of the data from the interviews centered upon the key elements of activation, information seeking, and deliberation stages set out in the theoretical background section. In addition, for the purpose of the analysis we assigned all respondents to one of three main types of transportation modes: car; public transit modes (train, metro and bus); active modes (walking and cycling) and explained the process of travel habit formation and decay based on the mode used before the relocation.

4.1. Activation Stage

Based on the information gathered in table 3 for all participants, it can be understood that making decisions regarding home relocation, is triggered by a complex interplay of stimuli that lead the decisions with respect to the priorities and importance for the decision makers. The three most frequently mentioned reasons for moving across the sample as a whole were: 1) to acquire a larger living space; 2) for investment purposes; and 3) to reduce commute distance.

Changing the commute to work was among the primary motivations for relocation for eight participants. These individuals chose to live closer to their workplace to have shorter commute distance. According to the residential self-selection hypothesis, these participants self-selected themselves by choosing to live in residential locations that correspond with their travel-related needs and preferences (Bohte et al., 2009). However, in cases of couples where moving favored only one of the two mates, the relocation decisions centered around gender-related considerations or flexibility of working hours.

> *"... you know, it was my first job, I didn't pay attention to the transportation, ... but after around six months my husband told me: no! It doesn't work. You are a woman and commute in winters is very difficult for you. So, it is better that we relocate to south shore to find a place that is closer to your work." (Olivia, age 33) - (Olivia and Liam relocated home to get closer to Olivia's workplace)*

"My husband has fixed job hours, like 7:30 to 4:30. But for me as a researcher it's more flexible. I can commute outside of peak hours … So, we decided to live closer to my husband's workplace rather than mine, even though my commute is now much longer than before." (Sarah, age 31) - (Sarah and James relocated home to get closer to James' workplace)

For others, once the decisions for relocation had been made and different location alternatives were considered, then the individuals attributed importance to the travel to work. For one couple whose main motivation for the move was to buy their first house, commute to work was not a salient priority at the beginning but this became a significant issue several months after the relocation which made the couple think about a second relocation. However, considering that the relocation was a voluntary change which turned out to be satisfying in most aspects, the negative impacts of experiencing a longer commute time after the move on overall life satisfaction appeared to be less compared to the long travel time experienced before the move.

Generally, in cases of our sample, the commute had more or less an influence on residential relocation decisions. Different aspects of the journey-to-work were thought to be important based on the participant's needs and preferences. While some participants prioritized the ease and speed of commute regardless of the mode, others directed all relocation decisions towards being able to use a particular mode of commute.

In addition to the change of commute distance, home relocation was related to the travel patterns in some other ways. In cases were home relocation was triggered or coincided by another life event travel patterns were influenced differently based on the nature of the event happened. The three familial events which were observed among the sample include expecting a baby, moving in together, and sickness of a partner. The first two events – generally categorized as family expansion – prompted the need for a larger living space while the third event brought about the issue of living close to a particular medical center. Müggenburg et al. (2015) highlights that residential relocation can be considered as a long-term mobility decision rather than a key event per se, if it is necessarily caused by another event such as the birth of a child. However, in the case of our sample, home relocation was indeed the leading event that would have taken place even in the absence of the other prompts. For three participants, the birth of a child forced the female partner to stay at home during the one-year maternity leave after the relocation. This left the male

partner with more freedom of choice with respect to commute distance or the use of the car for commute:

> *"... although we knew that I'll get back to work after one year, the fact that I was free of commuting for the first year after our relocation affected our decisions regarding whether to buy a house closer to my husband's job or to my job ... Finally, we found that it's more reasonable to live closer to his job, you know? And then we'll see what happens next year. Never knows! I may find another job or something." (Sarah, age 31)*

In the case with the illness of one household member the story was different. For this household, the main motive for the move was "*purchasing home as an investment" (Ben, age 44)*. However, the sickness of the female partner forced the family to stay close to the medical center where they had to visit frequently. Having to live near a hospital which was situated within a relatively expensive residential district within the city center, the household changed their decision from buying a house in the suburb to buying a condo in the downtown area. Ultimately, this purchase provided a good accessibility to public transit, variety of amenities as well as the school of their child who was going to experience a long commute using the school bus if the idea of moving to the suburb had been realized.

4.2. Information Seeking Stage

Almost all participants allocated some times to travel issues that they would face after the relocation. These considerations which ranged from rehearsing the new commute journey during peak hours to building up imaginations based on the previous experiences of the new location varied among participants based on their personal characteristics and the significance they attributed to the travel issues. Moreover, these considerations took place at different stages throughout the relocation.

Seven couples and one male (together 15 participants) in our sample purchased the new home. All of these travelled, at least once, to the new location during the purchasing process to observe the new neighborhood with regards to its level of liveliness/tranquility and accessibility to shopping and green areas. In contrast, for those who continued to be a tenant in the new home, the information seeking stage was shorter and less salient as they saw the new location as a temporary choice which requires less amount of proactiveness.

Among our sample, female participants gathered more detailed information regarding their own and the household's new travel options. Using applications such as the Google Maps and Société de transport de Montréal (STM), these participants searched for accessibility and distance to public transit, amenities and services around the new home. Three women with strong travel-related concerns in our sample put a considerable amount of time into the information seeking stage. For these participants, time loss during the peak hours was very important that they rehearsed the new work journey a couple of times before the relocation. They also talked to their friends and real estate agent about the transportation possibilities and constraints of the new home location.

In addition to the difference in the nature of the search, information seeking took place at different stages throughout the relocation. Those who had travel considerations as one of the primary motives for the relocation itself stopped collecting travel information once they relocated and continued their commute using the same mode for a long period of time. Others who had attributed less significance to their commute mode and route before the relocation, started to evaluate their alternatives a couple of months after the move. For instance, one couple who opted for purchasing a car, thought about the pros and cons of their choice and the related budget managements and looked for available options six months after they relocated.

4.3. Deliberation Stage; travel decisions by mode

After the prompt for relocation emerged and conscious considerations of travel issues came into play, some individuals took travel-related actions in anticipation of or adaptation to the relocation. These actions included purchasing of a car or a bike, acquisition or disposal of a public transit ticket, changing activity spaces such as shopping, gym, bank, or even workplace, changing the trip chains, changing travel mode and travel time. In this section, these actions are explained. In addition, for the purpose of the analysis we assigned all respondents to one of three main types of transportation modes: car; public transit modes (train, metro and bus); active modes (walking and cycling) and explained the process of travel habit formation and decay based on the mode used before the relocation.

4.3.1. Car users before the move - Deliberation stage

In the sample of cases analyzed, car ownership showed to play a substantial role in residential relocation decisions. The ownership of a car provided more freedom of home location choice and flexibility of mobility compared to households with no car. In six cases of car owners, one partner

did not take into account his/her own commute distance in favor of the other family member's access to work or school because the ownership of a car provided the possibility of having an "acceptable" commute trip. In four households, one of the two partners picked up and/or dropped off the other partner at metro station or at his/her workplace after the relocation.

One respondent explained that owning a car was the only reason that he did not consider his own commute distance even when he was applying for a job. This person, who drove more than 100 km for commuting (to and from work) everyday, gave priority to his family's comfort by choosing to live in a neighborhood with good access to the school of their child as well as public transport and amenities.

> *"Our reason for relocating to this place was having access to a better primary school for my daughter and the fact that my family lives in a good neighborhood … you know, they are really more convenient here … you know, if I didn't have this car, I can say I couldn't find this job, in fact, then it [current workplace] was not in my area of preference when I was searching for jobs." (George, age 46)*

Six males in our sample (John, Dave, George, Jack, Mike, Daniel) were classified as car users before the relocation of their home (Table 5). All of these remained car users after the move. This observation is in line with findings from previous studies on asymmetrical carryover effects and the dependency of car ownership (Clark, Chatterjee, et al., 2016a; J. M. Dargay, 2001; J. M. Dargay & Hanly, 2004). These studies revealed that during a life event people who use car change their transport mode less often than persons using other modes. It is, indeed, suggested that car ownership in a previous time period is a strong predictor of the car ownership state in the current situation. Except John, others experienced a similar or shorter commute distance after the relocation but chose to continue driving to work for different reasons. For John and George, travel to work using public or active transport modes seemed irrational. Although their work locations were not inaccessible by metro and bus on the map, a one-way commute trip by public transit took around two hours because the service was infrequent and required multiple transfers between modes. For both John and George, reduction of commute distance was not a first priority when searching for a new home, however, both participants highlighted that the experience of a two-hour commute (one hour each way) every day is very tiring that makes them think about a second relocation sometimes.

Dave's job required traveling to different locations around the city every day which made him highly dependent on his car both before and after the relocation.

> *"The nature of my family and business commitments on a daily basis do not permit me to use public transport. This is mainly due to the fact that in terms of geography and time, using public transport does not make it possible for me to meet my clients in due time as well as to make sure certain level of care is given to my child and extended family." (Dave, age 49)*

Jack, Mike and Daniel who had serious commute-related concerns chose to live closer to their workplace. However, surprisingly, they all continued driving to work for the first year after the move. Mike explained that the inaccessibility to adequate public transit service around his former residence was the main reason that he developed the habit of car use. After around one year, Mike and Daniel, purchased a bicycle and cycled to work on days with no daily errands after work and when the weather was nice.

> *"... to be honest, after we moved to this house, I always used my car not because it was the only way of coming to work but because I used to use my car for long time before we relocate. I was sort of dependent on it for no good reason." (Mike, age 39, who chose to ride his bike after one year.)*

From the psychological point of view, this finding suggests that using a car can call for further use of it because the habit of driving for commuting makes such behavior more desirable (Kaufmann, 2000). Four of the six male participants who used car for their commute trips both before and after the move, perceived themselves as strong-habit travelers. For these individuals the habit of car use was so strong that they chose to drive for both work and non-work trips even when they had good access to public transit.

George and Mike identified themselves as flexible travelers who can easily manage their trips using other transport modes if the physical environment provides the opportunity for this behavior. George highlighted that he dislikes driving to work but he has no other option:

> *"... For sure! If there is ever a train or metro ..., I would certainly use that even though it's not cheaper than traveling by car ... when I'm driving, I have to be concentrated and careful so I don't listen things that require attention, may be music or something like that. ... I can't use my travel time in that sense*." (George, age 46)

One significant issue that was highlighted by most participants was the impact of weather conditions on travel mode choice. Active transport, i.e., walking and cycling, were the most vulnerable to variations in the weather, particularly to the severe and long-lasting winters in Montreal. Among the nine interviewees who walked or cycled to work sometimes before or after the relocation, using a car was still prevalent especially from November to April.

> *"... I have to remove the snow from the driveway and wait for the car to warm up both in the morning and in the afternoon – well, my workplace parking is outdoor – and all of this plus my commute time take more time than walking to work, but I still prefer to drive in snowy and very cold days. Even public transport doesn't work." (James, age 37)*

Table 5 presents a summary of residential characteristics, commute distance and accessibility to public transit for before-the-move car users. Among the relocators, John, Jack, Mike and Daniel self-selected to purchase a residential property in low-density residential areas. A decrease in density, mixed use, and access to frequent bus lines in the new residence can explain to some extent why these commuters continued driving for commute trips in spite of experiencing a shorter commute distance after the move.

Table 5: Residential density, home-work distance, and accessibility to public transit for car users before the move

Car users before the move	Residential density		Home-work distance	Access to PT after the move	Mode used after the move
	Before	After			
John, age 35	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a townhouse	Increased Travel time almost doubled	Reduced access to frequent bus lines	Car
Dave, age 49	High-density mixed-use area inside Montreal Island– Tenant in apartment	Similar to the before-the-move location (Moved in together with Anna)	Remained almost the same as he traveled to various locations each day	Good access to public transit before and after because for Anna access was the first priority	Car
George, age 46	High-density mixed-use area inside Montreal Island– Tenant in apartment	Medium-density mostly residential – Tenant in apartment - within walking distance of his child's school	Remained the same (around 50km)	Reduced access to frequent bus lines	Car
Jack, age 40	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a condominium	Reduced	Reduced access to frequent bus lines	Car
Mike, age 39	Low-density residential area outside of Montreal	Low-density residential area outside of Montreal	Reduced Travel time almost halved	Reduced access to frequent bus lines	Car

	Island – Tenant in apartment	Island – Purchased a semi-detached house			
Daniel, age 41	High-density mixed-use area inside Montreal Island – Tenant in apartment	Medium-density residential area inside Montreal Island – Purchased a detached house	Reduced Travel time almost halved at the beginning but again doubled when Daniel changed his job	Reduced access to frequent bus lines	Car

4.3.2. Public transit users before the move - Deliberation stage

Before the relocation of their home, eleven participants were public transit users (Table 6). Of these, six remained mainly a public transit user (Sarah, Anna, Liam, Alice, Beth, Emily) and five changed their commute mode (Emma, James, Ben, Olivia, Abigail). Liam and Emily found that for work trips public transit is more efficient than other means of transport in terms of money and speed but for non-work trips they mostly relied on their private car. These participants used car for commute only when they had some after-the-work errands to complete.

For Sarah, Anna, and Beth residential relocation decisions were highly transport-oriented. These participants who called themselves a green transport advocate searched solely for homes in close proximity to a metro station or a frequent bus line while Sarah and Anna both owned a car. Six months after the move, Anna started to cycle to work using a straight bicycle lane on the new home-work route:

> *"Being an environmentalist, having access to public transport was one of the most important criteria in choosing the location of my house. ... we relocated in November, not so good for cycling to work, you know. Besides, I didn't feel like riding my bike at the beginning. It took me sometimes to know the area and the bike passage and stuff." (Anna, age 34)*

For Sarah and Alice, home-work journey required taking a bus from home to the metro station. Since the bus was quite infrequent and the service was slow during the evenings, Alice preferred to be picked up or dropped off at the metro station by her spouse instead of driving to work by herself:

> *"I'm lucky that my work hours match with my husband's schedule. I work during the evenings. When I start to get to work, he is already done. So, he takes me to the metro, I go to work, then come back using the metro again and then he comes and picks me*

up … I have no problem taking an express bus [from the metro to the home], but all the buses come every thirty minutes or more at that time of the day." (Alice, age 37)

Interestingly, Sarah, Anna and Alice all had flexible working hours most of the days. This was mentioned as an important factor in choosing public transport over car for commute. In fact, as public transit was found unreliable most of the time, the use of it for work trips was avoided if high level of punctuality was required at work.

Of those who stopped using public transit and switched to car-based commute after the relocation, Emma, Ben and Abigail found public transit to be less efficient from the new residence. Ben explained:

"Before the move we lived right in front of a frequent bus line and now we don't. This changed the commute to the private car, of course! … I do like and I prefer public transport when it is easily accessible because it takes the hassle off the private car, parking, all of that. … of course, it [public transport] reduces the air pollution, … but that is, personally … secondary for me. So, efficiency is a bit more favorable than exact environmental impacts." (Ben, age 44)

For James and Olivia, the new home-work journey was less than a 15-minute walk. Indeed, James, Olivia and their partners prioritized having a commute time of less that 30 minutes when searching for a new home. However, both participants started to commute by car immediately after the move and continued this habit for the first six months mainly because it provided more flexibility and versatility in a situation where a considerable change in the activity space was experienced. Although James and Olivia developed a temporary habit of driving to work after the move, they both showed a negative perception about car as a travel mode, which finally made them quit this habit and develop a new one. In these participants' opinion, car was an expensive, pollutant, tiring, and somewhat dangerous commute mode. This observation is consistent with findings from Clark, Chatterjee, et al. (2016b) who indicated that commute mode changes are highly affected by alterations to the home-work distance which occur in association with moving home.

James explained:

"… I was excited to drive to work not just because it was a new way of commuting but because …umm, I don't know probably because everyone else did, I mean a lot of my colleagues came by car, I don't know. … well, after about five months that we started to settle down in our new home I found driving to work much less exciting

and even a waste of time as it took me only 15 minutes if I walked from home to work, door to door. … So, I now ride my bike to get to work and I think it's the most efficient and enjoyable one for traveling to work …" (James, age 37)

Olivia explained:

"… you know, after we moved to this house I started to go [to work] by car because it took me only five minutes to arrive and I really wanted to be punctual … after sometimes, if I remember correctly, something about six, seven months may be, I started to walk to work. … It takes me around 10 minutes or I take the bus if the weather isn't nice." (Olivia, age 33)

Similar to Mike (car user before the move), James and Anna did not switch to cycling immediately after the move; they rather developed this habit a couple of months (to a year) after the move. The reason underlying this delay was related to the nature of bicycling. Adding fun and pleasure of riding a bike to work trip – a trip that is associated with certain disciplines (punctuality and non-sweaty clothes at work) – requires the travelers to be fairly stress-free by having a relative control over their life situation. This condition was acquired a couple of months after home relocation for these participants. James and Anna favored cycling over other modes of transportation, because of its pleasure, flexibility, the physical activity associated with its use, relatively high travel speed and low cost.

Table 6 presents a summary of residential characteristics, commute distance and accessibility to public transit for before-the-move public transit users. Of this group, most participants self-selected to purchase a residential property in an area with decreased density, mixed use, and access to frequent bus lines which is one of the underlying reasons for observing more car use after the move.

Table 6: Residential density, home-work distance, and accessibility to public transit for public transit (PT) users before the move

PT users before the move	Residential density		Home-work distance after the move	Access to PT after the move	Mode used after the move
	Before	After			
Sarah, age 31	High-density mixed-use area inside Montreal Island – Tenant in apartment	Medium-density residential area outside of Montreal Island – Purchased a detached house	Increased Travel time almost doubled	Reduced access to frequent bus lines	PT

Anna, age 34	High-density mixed-use area inside Montreal Island– Tenant in apartment	Similar to the before-the-move location (Moved in together with Dave)	Reduced	Remained the same – Good access to PT before and after because for Anna access was the first priority	PT and later bicycle
Alice, age 37	Low-density residential area outside of Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a semi-detached house	Increased Travel time almost doubled	Reduced access to frequent bus lines	PT and Car
Beth, age 34	High-density mixed-use area inside Montreal Island – Tenant in apartment	High-density mixed-use area inside Montreal Island – Tenant in apartment	Reduced	Increased access to frequent bus lines	PT
Emily, age 42	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a condominium	Reduced	Reduced access to frequent bus lines	PT
Liam, age 36	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a detached house	Increased travel distance and time	Reduced access to frequent bus lines	PT
Emma, age 32	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a townhouse	Increased Travel time almost doubled	Reduced access to frequent bus lines	Car
James, age 37	High-density mixed-use area inside Montreal Island – Tenant in apartment	Medium-density residential area outside of Montreal Island – Purchased a detached house	Decreased significantly	Reduced access to frequent bus lines	Car and later bicycle
Ben, age 44	High-density mixed-use area inside Montreal Island – Tenant in apartment	High-density mixed-use area inside Montreal Island – Purchased a condominium	Remained almost the same	Reduced access to frequent bus lines	Car
Olivia, age 33	High-density mixed-use area inside Montreal Island – Tenant in apartment	Low-density residential area outside of Montreal Island – Purchased a detached house	Decreased significantly	Reduced access to frequent bus lines	Walk
Abigail, age 40	High-density mixed-use area inside Montreal Island – Tenant in apartment	Medium-density residential area inside Montreal Island – Purchased a detached house	Decreased	Reduced access to frequent bus lines	Car

4.3.3. Active transport users before the move - Deliberation stage

One man and two women in our sample (Laura, Sophia, Nik) traveled to work on foot before the relocation (Table 7). These participants who lived within a 20-minute walk from their workplace found walking pleasurable and faster than public transit and a good way of doing daily physical activity. After the relocation, however, all three participants experienced a longer commute distance and their workplace was no more within the walking distance of their home though easily accessible by public transport. Laura and Sophia continued their commute trip using one straight bus from home to work while Nik chose to be picked up and dropped off at workplace by his partner. Nik and Sophia were a couple with a one-year old child who started to go to daycare one year after the relocation. This couple were another example of those who chose to live in more urban areas within walking distance of frequent bus lines.

All three participants of this group remained a renter after the move, but they were highly concerned about living close their workplace and an efficient public transit service. Sophia and Nik stated that being unable to invest their money in purchasing of a residential property, they were more strongly intended to save money on transportation. The relatively affordable rentals of downtown Montreal also provided the possibility of this choice for this couple.

Table 7: Residential density, home-work distance, and accessibility to public transit for active transport users before the move

Active transport users before the move	Residential density		Home-work distance after the move	Access to PT after the move	Mode used after the move
	Before	After			
Laura, age 31	High-density mixed-use area inside Montreal Island – Tenant in apartment	Similar to the before-the-move location	Increased	Remained highly accessible	PT
Sophia, age 32	High-density mixed-use area inside Montreal Island– Tenant in apartment	Similar to the before-the-move location	Increased	Remained highly accessible	PT
Nik, age 37	High-density mixed-use area inside Montreal Island– Tenant in apartment	Similar to the before-the-move location	Increased	Remained highly accessible	Car

4.4. The relationship between different levels of habit strength and willingness to change

Based on the discussions, participants were categorized into three groups with respect to their habit strength: 1) Strong habit of car use; 2) Green transport advocates; 3) Flexible travelers. For participants of all three groups, travel habit was weakened immediately after the relocation not only for those who changed mode but also for those who did not. Those who did not change mode were grouped into two based on their reason for continuing the same travel mode: 1) those with strong travel habits who didn't change even though they had cheaper or faster alternatives at disposal; 2) those with weak travel habits who didn't change because this choice provided the highest utility among others. Among the latter group most participants stated that even though they continued to choose the same travel mode after the relocation, they made their choice a lot more consciously and deliberately than before the relocation. These people indicated a high level of searching-for-alternatives by consulting internet tools and apps and talking to others including their real estate agent and colleagues at work.

- **Strong habit of car use**

This group includes five male participants who drove to work both before and after the relocation due to their strong dependency on private automobile. In other word, whether they had after-work errands or not, whether they had access to public transit or the possibility of commuting by bicycle, and whether the weather was nice or not, these individuals preferred driving for both work and non-work trips. In fact, the key event of residential relocation could not affect their strong habit.

> *"... to be honest, after we moved to this house, I always used my car not because it was the only way of coming to work but because I used to use my car for long time before we relocate. I was sort of dependent on it for no good reason." (Mike, age 39, who used car before and after the move.)*

With respect to the willingness to change and the use of different green transport encouragement policies, these participants showed the least interest among other participants. Among the eight strategies proposed, these individuals seemed to be more willing to either lightly stagger their work hours or work from home. It should be acknowledged, however, that there is not particularly strong evidence to support the discussion in this section as only small number of participants have been evaluated in that respect.

- **Green transport advocates**

The second group included six participants who identified themselves as travelers who are against driving specially for work travels and therefore managed their residential relocation decisions in a way to be able to complete their commute either with public or active transport modes. In fact, the key event of residential relocation could not influence the strength of their beliefs; rather it was their strong environmental concerns that guided their moving decisions:

> *"I think I am somehow environmentalist. I am upset about what's happening to our planet and I don't want to add to it." (Anna, age 34)*

For these participants, four of whom owned a car and two of whom easily able to afford one, the flexibility and speed of car use, especially for commute - as discussed by other participants - was highlighted nowhere during the interview. Again, this observation can be explained by the concept of residential self-selection. In fact, individuals with a preference for public and active transport opted for residential locations within walking or cycling distance of a bus stop or metro station:

> *"Either walking or using public transit for commute really help me clear my mind and get ready for the day. But, driving, no! you can't process your day when you're too busy driving and you're stressed out by what's happening on the road or getting stuck in the traffic. I really wanted my husband and I to live somewhere accessible by public transit that doesn't require driving every day during the nightmare of rush hours specially on the bridges, you know…" Sarah (age 31)*

These participants were fascinated by most of the eight green-transport-encouragement policies. Participating in informational campaigns and attending workshops about transportation opportunities were among the strategies in which this group showed greater interest compared to the other two groups. In favor of reducing their environmental impacts, these participants acknowledged to be interested to be actively involved in such planning policies.

These individuals spent a considerable amount of time on travel issues during the first months after the prompt for the move emerged. Travel issues for this group were indeed part of the stimulus for the relocation decision. For this group, the period of information seeking included talking to their real estate agent about their travel concerns; searching for transportation opportunities and hours of operation and their desired activity spaces in the vicinity of the new home using the Google Maps and mobile apps such as the STM or Transit; and looking into the travel time in and out of peak hours to speculate a rough estimation of their commute time. Three out of six participants of this group rehearsed the new journey by traveling from the new home to their workplace.

- **Flexible travelers**

The rest of the participants are categorized as flexible travelers in a sense that they consciously considered travel issues during the period of home relocation but their flexibility in choosing different alternatives led them not to focus on the travel-to-work as a major priority in their home relocation decisions. These individuals considered the ease of getting to work, rather than preferring a particular mode. One participant who made plans to commute by public transit before he relocated, made some subsequent adjustments by driving on some days and riding the bike on some other days and leaving public transit use for sever winter days when his spouse needed to use the car.

It is however important to note that in some cases, it was the ownership of a private car that provided a feeling of having the potential to eventually manage the commute trips when the use of other travel options was impossible. Regarding the green-transport-encouraging policies, this group showed more interest in reading booklets and websites about green transportation opportunities and also accepting to use a subsidy for public transit.

Our interviews with this group acknowledged the finding that habits are not always strong predictors of behavior change. If the convenience of travel is provided using public or active transport, flexible-habit travelers are very likely to adopt these modes at the expense of reducing their car use. This will indirectly support the idea that spatial and infrastructural factors are of prime importance in travel actions (Walker et al., 2015).

5. Discussion

Commute trips among all daily trips and distances made by individuals are more likely to be influenced following a residential relocation. However, the best way to assess commute habits formation and decay is to consider home relocation as a process that extends over a period of time before and after the event. Our qualitative survey on a sample of twenty individuals who had relocated home in the previous two years demonstrated that depending on the commuter's travel habit strength and the commute mode used before the relocation, travel decisions can be made differently and at different stages before and after the relocation. The three identified groups of travelers include *strong habit of car use*, *green transport advocates* and *flexible travelers*. Although conscious considerations of travel issues were prevalent among all participants, some

directed their choices to be in line with their previous habits and avoided information or factors that might challenge their before-the-move routines. Both the green transport advocates and those with strong habit of car use had travel considerations as one of the primary motives for the relocation itself. However, once post-relocation commute experiences have been encountered, lower degrees of reappraisal of travel options was observed for these participants. Observations of these individuals revealed that strong habits, whether positive (in favor of low-carbon transport modes) or negative, are unlikely to change, even in the wake of a major voluntary life event. The unlikelihood of change for **positive** strong habits, however, is always desirable as habits can acquire a normative flavor and sustain by social approval and thus remain functional both before and after a life event (Verplanken et al., 1998). Therefore, what is often presented by the relevant literature as strong habit is not necessarily a habit, but it can be a strong belief or personal norm such as an environmental concern. In confirmation to findings from Verplanken et al. (2008) vis-à-vis the direct impacts of activated values on behavior change after the occurrence of a life event, our study tend to indicate that when a major life event activates environmental concerns of those with strong habit of public or active mode use, these individuals show stronger propensity to act upon their personal values and beliefs by self-selecting to live in a neighborhood that would allow them to remain a green transport advocate. Flexible travelers on the other hand, considered travel mostly when locating viable areas in which to search for a new residence as well as after the move when they examined different modes according to their day-to-day situations and preferences. Therefore, home relocation is more likely to change these individuals than the other two groups. These observations confirm finding from Stanbridge et al. (2004) who conducted a cluster analysis to identify typologies of home-movers. The authors indicated that different levels of travel considerations may occur at different stages during the process of residential relocation. The present study completes finding from Stanbridge et al. (2004) by providing deeper insights into the concept of habit strength. Figure 1 shows travel-related decision-making process around the period of relocation for weak and strong habit travelers. This diagram completes Klöckner's model, first, by highlighting the fact that home relocation is a period which encompasses various stages for travel considerations, and second, by distinguishing between different degrees of habit strength. Overall, the interviews indicated that commuters, regardless of their habit strength, are basically motivated by convenience, speed and versatility when selecting commute modes during the process of relocation.

Regarding the strategies that encourage the use of green transport modes our three groups showed different levels of willingness to change. The green transport advocates were found to be more or less impressed by most of the policies relative to the other two groups. On the contrary, those with strong habit of car use showed more interest in working from home and staggering work hours in order to reduce their environmental impacts. For these participants, ridesharing with colleagues for travelling to work was one policy that they would adopt if its benefits outweigh the problems. In other words, as long as the convenience and speed of their daily commute was not compromised, they would choose to share ride with their colleagues. Since this is a qualitative study with a small sample size, we cannot draw generalizable conclusions about these findings, but it is worth mentioning and worth further studying.

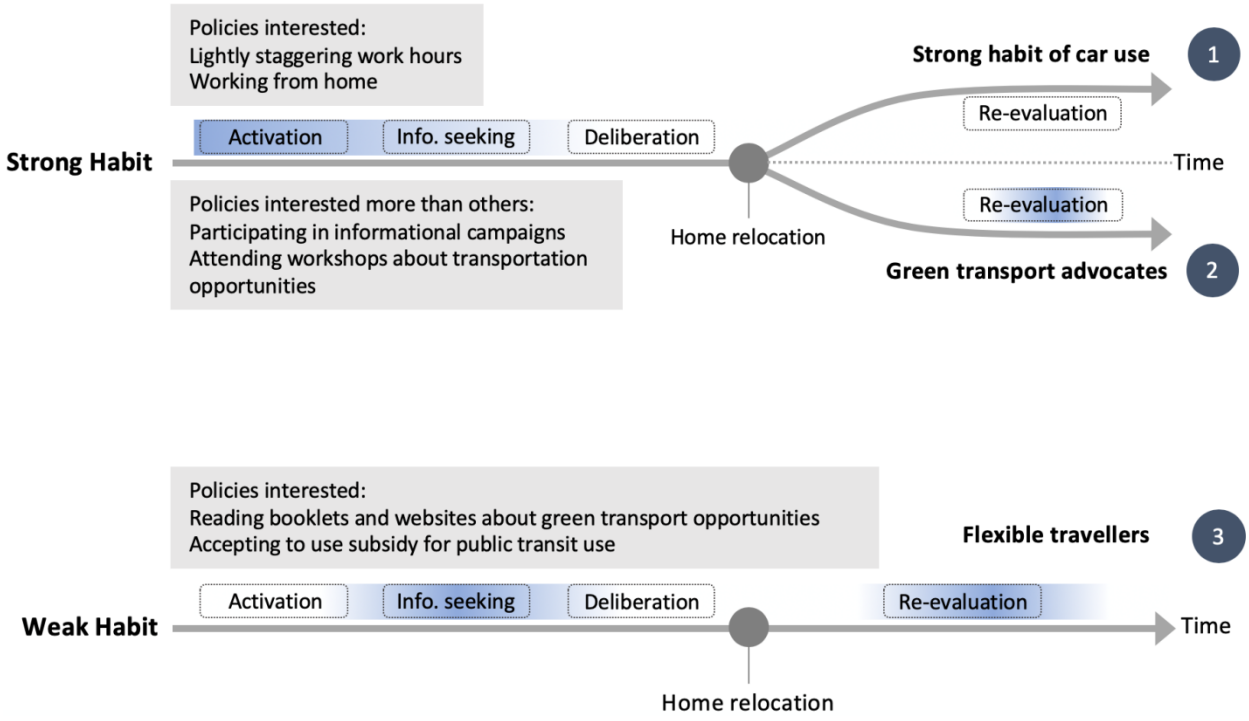


Figure 1: Decision-making process for weak-habit and strong-habit participants around the period of relocation - Source: Author.

6. Conclusion

First, it is important to mention limitations to our study. Recruitment via social media is not easily controlled and can introduce biases. Furthermore, the participants in the study all came from the community of well-educated immigrants, this may also bring bias. However, the diversity of the sample in terms of job type, home location, and other socio-economic factors helps to reduce any

possible biases. Regarding the method of analysis, we developed coding tables in order to extract key points in the interviews. This method facilitates and accelerates the process of data analysis, since the transcription and the data analysis take place simultaneously. However, we should mention that this method decreases the possibility of spontaneous new findings because the transcripts are limited to specific key points.

To our knowledge, only a few studies have qualitatively analyzed habit strength across travel modes during the process of a life event. The objective of this paper was to ascertain the impact of one specific voluntary life changing event, home relocation, on households' commute behavior. Twenty qualitative retrospective interviews with recent home movers were conducted. The first aim of this paper was to evaluate decision-making process during the travel habit reconfiguration stages around the period of relocation. Our analysis reveals that travel considerations, especially commute journeys, can play a prominent role in home relocation decisions. Not only can these considerations be part of the prompt for the move itself (for green transport advocates in our sample), but also, they are associated with decisions related to finding viable neighborhoods in which to seek for a new property. Moreover, once the post-relocation travel-to-work has been experienced, travel considerations associated with re-evaluation of travel options are likely to emerge again (for flexible travelers in our sample). The second aim of this paper was to identify different typologies of individuals vis-à-vis travel habit strength and mode choice before and after the residential relocation. The interviews revealed three types of travelers in terms of habit strength and willingness to adopt green transport policies: 1) Strong habit of car use; interested in staggering work hours and working from home; 2) Green transport advocates; interested in all the eight strategies, specially participating in informational campaigns and attending transportation workshops; 3) Flexible travelers; interested mainly in using subsidy for public transit and reading booklets and websites about green transportation opportunities.

The analysis and results presented in this study emphasize on the importance of residential relocation as a voluntary key event in life that influences considerations of daily travel-to-work to a great extent. The fact that different typologies of individuals will behave differently in face of such change in life, should be of interest and relevance to policy makers and transportation planners who aim to encourage sustainable transportation and less automobile dependency specially for commute journeys. This study shows that communication and marketing efforts for

travel-mode changes are more likely to be successful if they are targeted to both flexible travelers and motivated individuals especially during the information seeking phase before the move and the re-evaluation phase after the move. It should be acknowledged, however, that finding the right people at the right time during the moving process is a challenge that requires further attention in future research. For instance, by making a link between transportation planners and real estate agents, movers can participate in short surveys regarding their daily commute and travel considerations.

It is important to note that habit strength is not the only factor influencing individuals' behavior during a life event. The degree of proactiveness to changing circumstances, i.e., planning ahead of time to avoid potential problems, is another factor which can be of interest for further research. It is still unclear how different degrees of habit strength when combined with levels of proactiveness may influence the flexibility of individuals in adopting alternative transport modes.

It is also relevant to see what costs each type of traveler is ready to pay and what it takes for each type to choose more sustainable transport modes. Normally, green transport advocates are ready to pay a more important cost in terms of time, money and effort to keep using green transport. However, for individuals with strong habit of car use and also for flexible travelers, commute choice might be a function of the speed and reliability of the infrastructure and the possibility of combining various transport modes.

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