Sustainable Transportation and Social Demographics at Uptown Waterloo

by

Geoffrey Chase

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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of my thesis, including any required final revisions, as accepted by my examiners.

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Abstract

This thesis investigates how the use of a mid-size city's core is related to the transportation preferences and socioeconomic status of its residents. Uptown Waterloo was chosen as a study site because, in addition to its social and economic functions, it is intended to be the centre of the city's active and public transportation networks. As such, it is important to planners and policymakers to assess not only how widespread the use of sustainable transportation is among Uptown shoppers, but also how equitable it is. Online and in-person surveys of Uptown shoppers were administered in summer 2014 to determine the social profile of an Uptown shopper, the transportation methods used to reach Uptown, and the types of activities performed during a visit.

Respondents showed a strong preference for sustainable transportation methods, with only 28% visiting Uptown most frequently by car. Moreover, people who bicycled or walked to Uptown were found to have comparable spending habits to drivers but visited the site more times per month. The respondents were on average younger, more affluent, and more drawn to jobs in the knowledge economy than the social demographics of the Waterloo region can account for. A significant relationship between travel mode choice and economic status was observed: drivers were most affluent on average and public transit users the least, while methods of active transportation were more socioeconomically heterogeneous. Although the demographic profile of Uptown shoppers is consistent with indicators of social gentrification, the findings suggest that the City's ongoing promotion of sustainable transportation supports Uptown's businesses as well as a broad range of its visitors.

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1. Introduction

1.1 Sustainability and the Urban Landscape

In recent decades, strategies of sustainable development have gained popularity in Canadian urban planning discourse. The neo-traditional urban landscapes of the New Urbanist movement (CNU, 1996) and the Smart Growth paradigm's distribution of services and amenities (Duany & Speck, 2010) present attractive – and marketable – images to planners and developers. Moreover, they offer the promise of a revitalized city centre: a diverse, engaging landscape, attracting visitors from across the city to mingle at its heart. This ideal urban form is compact, complex, and connected; providing a high level of accessibility to shopping, institutional, and recreational space (Clifton, Ewing, Knaap, & Song, 2008) While this physical layout serves to focus development on the urban core, its concentration of amenities encourages (De Nisco & Warnaby, 2013; McIntosh, Trubka, Kenworthy, & Newman, 2014) alternative transportation methods that offer health and environmental benefits at reduced public cost (Banister, 2011).

Many cities could use the help. Mid-sized North American cities in particular have had their core population and density erode over the past decades (Bunting, Filion, Hoernig, Seasons, & Lederer, 2007; Weitz & Crawford, 2012). The contemporary metropolitan area is largely dispersed, which heavily favours personal vehicle use over active and public transportation options like walking, bicycling, and taking the bus (Bagley & Mokhtarian, 2002; De Vos, Van Acker, & Witlox, 2014; Kenworthy & Laube, 1999). Revitalization efforts, then, are a chance to bring the city back to the city: to stake out a visible, attractive core in a way that places valuable services within easy reach of the city's residents. The potential social benefits of such a strategy are much touted, as is the potential of a dense, accessible central city to reduce the city's

environmental footprint (Banister, 2011; T. A. Clark, 2013; Kenworthy & Laube, 1999). Whether these strategies can mitigate half a century or more of sprawl, and whether their services can truly be enjoyed by the diverse social and demographic groups of the city, depends on whether the plans look past the built form to matters of social equity (Quastel, Moos, & Lynch, 2012).

This study examines the urban landscape of the Kitchener-Waterloo-Cambridge metropolitan area with regard to the Uptown Waterloo Business Improvement Area (as delineated in Figure 1). This area is intended to be the commercial, economic, and social core of the city; a hub in its active and public transport area; a branding initiative for the city; and a flagship of recentralization in a landscape that has been defined by half a century of suburbanization. In this investigation, the shopping habits of local residents are compared against their travel preferences, their sociodemographic characteristics, and their distribution within the region. This contributes to the currently sparse body of knowledge shopping activity in the context of transit choices; investigates the plans to redevelop Waterloo's core for its potential to affect the surrounding housing markets; and asks how plans to promote sustainable transportation and development might differently affect the diverse elements of Waterloo's population.

1.2 Waterloo and Uptown

The Region of Waterloo is in the midst of engineering its transition from a dispersed, car-oriented, heavily suburbanized metropolitan area to a recentralized, transit-supportive form. Municipal and regional planning initiatives in the new millennium have consistently addressed this goal. The 2003 Regional Growth Management Strategy (Region of Waterloo, 2003)

Figure 1: Boundary of Uptown Waterloo (City of Waterloo, 2014b)

describes the region's goals in terms of several dimensions of reurbanization and sustainability,

including infill-focused growth management, a highly connected multimodal transportation network, and place-building in community cores through retail and housing development. Later planning efforts have addressed these policy goals, among them a regional transportation strategy (IBI Group, 2011) that stresses connectivity through active and public transportation. The City's most recent official community plan (City of Waterloo, 2014a) addresses intensification, accessibility, and place-building at length to promote smart growth in the municipality. These goals are reinforced by the province's Growth Plan for the Greater Golden Horseshoe (Ontario Ministry of Infrastructure, 2006), which establishes a growth boundary and highlights zones within the metropolitan area for targeted intensification efforts as Urban Growth Centres.

These efforts are necessary. Decades of low-density, car-oriented development have eroded the core of the metropolitan area, dispersing jobs, services, residents, and wealth to the periphery (Bunting et al., 2007; Pavlic & Qian, 2013). This trend towards suburbanization proceeded at the expense of the central business district despite occasional local efforts from the mid- to late 20th century (Filion & Bunting, 1993), producing a highly diffuse urban landscape that lacks distinguished hubs of activity (Filion, Bunting, & Warriner, 1999). As a consequence, before concerted efforts were made to change the fact, residents of the city were exceptionally dependent on cars to reach necessary services.

Since the 2000s, planning efforts in the region have developed a vision of a recentralized, better connected metropolitan area, drawing on principles of Smart Growth to do so (Brunt & Winfield, 2005). Intensification efforts are targeted on dense, mixed growth centres like Uptown Waterloo: core areas of diverse land use, with streetscapes designed to promote connectivity and interaction among visitors (City of Waterloo, 2014a). These are served in turn by a Central

Transit Corridor targeting King Street for re-urbanization according to regional residential and job densification benchmarks (Region of Waterloo, 2003). Beyond the areas targeted for revitalization, transportation policy emphasises making the city easily navigable by foot, bicycle, and public transport as well as by car (IBI Group, 2011); action points include public transit support, connectivity with urban greenways, increased bicycle infrastructure, and pedestrian-friendly streetscapes and sidewalks.

Thus, urban development in Waterloo involves a combination of revitalizing core areas and increasing the accessibility of those areas to people living throughout the city. In this, Uptown Waterloo presents itself as a case study. The Uptown neighbourhood has been highlighted by the province as Waterloo's Urban Growth Centre: an area for targeted residential and job densification which also emphasizes providing services to the surrounding region (Ontario Ministry of Infrastructure, 2006). It is also considered the City of Waterloo's commercial and cultural core (City of Waterloo, 2014a), with its business and employment lands complemented by cultural and institutional services, medium-density residential areas, and recreational space. Uptown also occupies a core location in the regional transportation networks (IBI Group, 2011), sitting in the middle of Waterloo's central transit corridor. Planning around Uptown Waterloo addresses its status as the city's centre through two broad means: managing the different ways residents of the region travel to Uptown, and managing the experience of visiting the site itself.

Transportation planning surrounding Uptown Waterloo has come to focus on pedestrian, bicycle, and bus transit, both to generate additional trips to Uptown and to reduce the mode share of personal vehicles. Methods of active transport are supported by the greenway and trail network that joins Uptown to the west, while streetscape features like bicycle lanes have been added to accommodate a greater share of cyclists and pedestrians (Brunt & Winfield, 2005).

Uptown is also a main stop for the region's bus service (IBI Group, 2011), as well as an upcoming light rail line. In general, primary obstructions to public transit use are negative attitudes towards it (Brunt & Winfield, 2005) and unfavourable impressions of its service (Lai & Chen, 2011), rather than any considered assessment of its amenity. Should this be consistent in Waterloo's public transit system, this emphasis of a core destination point for the transit network could serve to encourage uptake of the redeveloped public transit network. Certainly it is a primary node for the region's plans for an integrated multimodal transit network (Region of Waterloo, 2003).

1.3 Research Questions

This study evaluates the use of Uptown's businesses and services both in terms of their ability to meet the needs of the different sociodemographic groups of the municipality and their capacity to support the region's active and public transportation goals. To that end, it poses three questions:

1. *How does Uptown support sustainable transport in the region?*
2. *Is sustainable transportation use linked to socioeconomic status?*
3. *Do Uptown shoppers show high socioeconomic advantage?*

1.3.1 How does Uptown support sustainable transport in the region?

Uptown has the capacity to encourage the city's residents towards active and public transport. Its facilities include staple shopping, several varieties of niche and boutique shopping, food services, municipal services, and recreational space. The site itself exists at the intersection of two arterial roadways, several major public transit stops, and walking and bicycle trails. Several of the city's older neighbourhoods fall within walking distance, while higher-density areas saturated with student housing are almost as near.

In theory, it has a solid foundation as a commercial centre. The variety of activities act in its favour as a commercial node: its staple retail is useful to all social and neighbourhood groups (Handy & Clifton, 2001), while its specialty retail expands its customer base into niche markets (Filion & Hammond, 2008; Grant, 2006). Its food services and convenience shopping have a particular appeal to people visiting by bicycle or by foot (Clifton, Currans, Ritter, Morrissey, & Roughton, 2013). Its location and points of entry make it accessible to people arriving by all transportation modes. However, residents near transit-oriented intensification projects sometimes resist adjusting their behaviours to the facilities, (De Vos et al., 2014), so examining the rate of sustainable transportation uptake is worthwhile.

To gauge how Uptown is used by residents of the region, its visitors' activities are compared to their demographics and their mode of travel. Key considerations are whether public transit use and/or the active transportation modes of walking and bicycling are associated with more frequent visits, whether the spending patterns of people visiting by active transport differ from those of people coming by car, and how people arriving by different modes are distributed throughout the region.

1.3.2 Is sustainable transportation use linked to socioeconomic status?

A stated goal of the Uptown business improvement area is that it be supportive of sustainable transportation methods: bicycling, walking, and public transit. Its streetscapes are intended to be pedestrian-oriented, with traffic calming measures and fully integrated access to the city via the bus transit system. It is also intended to support a diverse metropolitan community with its shopping, amenities, and transport options.

While those different transportation options are available, it remains to be seen whether they are as freely available to the city's different sociodemographic groups. The city enjoys a

reasonably even distribution of different household types, lacks the degree of income polarization found in some Canadian cities (Ross, 2004; Walks & Bourne, 2006), and shows little relationship between household income and employment accessibility (Neudorf, 2014). In determining travel behaviour, however, the simple distribution of services relative to houses is matched in importance by lifestyle, attitudinal, and demographic dimensions (Curl, Nelson, & Anable, 2011; P. Jones & Lucas, 2012). The dimensions of accessibility in urban transportation networks are often poorly represented, adding an important element of equity to this line of inquiry (Stanley & Vella-Brodrick, 2009).

To investigate, this thesis considers whether the active and public transport opportunities offered by Uptown are used preferentially by any particular social and demographic group. Factors like travel distance, mobility, and availability of options are taken into consideration. Overall mode share is weighed against the different transport options used by individual respondents to consider whether people use different travel modes for different trip types, out of necessity, or as a matter of personal preference, according to their personal circumstances.

1.3.3 Do Uptown shoppers show high socioeconomic advantage?

Uptown is proximate to several different forms of residential landscape, from the older neighbourhoods nearby to the dense apartment- and condominium-based development to its north. There was a tendency for the city's older, central census tracts to house lower-income households (Filion et al., 1999), although the social composition of the neighbourhoods also played a part in its demographics: people nearing retirement and families with children exhibited a preference for less urbanized areas (Bunting et al., 2007). While Uptown has the potential to rekindle interest in these inner neighbourhoods, there is the caveat that core revitalization efforts have a tendency to consider built form but not matters of social inequality (Quastel et al., 2012).

The metropolitan area currently enjoys a relatively homogeneous distribution of sociodemographic groups, without the concentration of low-income households that some larger cities show (Walks & Bourne, 2006); it then follows that Waterloo's social and economic core should show the same diversity of customers.

As such, the thesis considers whether or not Uptown shoppers tend towards a higher socioeconomic status than the city's consumer base would suggest. In particular, the sociodemographic traits associated with a gentrifying population are evaluated. Typically, this favours high-income workers (Meligrana & Skaburskis, 2005) in the quaternary occupations of the "new middle class" (Quastel et al., 2012), often with a low proportion of immigrant groups and minorities (Fong, 2000). The distribution of Uptown shoppers' age and social groups, professions, and incomes are investigated for evidence of such a trend.

1.4 Research Themes

For ease of reference, Table 1 below summarizes the primary avenues of inquiry in this thesis, along with appropriate selections from the literature review. Section 5.2 revisits these themes with a summary of the research findings.

Table 1: Primary research themes and selected materials

Variables	Question	Data Source	Literature Keywords	Authors
Most-used travel mode, Primary travel mode	Do people disproportionately use sustainable transport to reach Uptown?	Web Survey	Active transit-supportive infrastructure, dimensions of accessibility, branding sustainable transport	Bent & Singa (2009); Teller & Elms (2012); Banister (2011)
Travel distance	Is mode choice distance-dependent?	Web Survey, Postal Codes	"Walksheds", Transit-supportive infrastructure, transport demand management	Millward, Spinney, & Scott (2013); Cervero & Kockelman (1997); Pucher & Renne (2003)
Travel time	Is mode choice dependent on travel time?	In-person survey	Urban density, public transit density, time- and route-based accessibility factors	Lenworthy & Laube (1999); Curl et al (2011); Filion et al (1999)
Most-used travel mode, Frequency of trips	Do people visit more frequently by active transport than by vehicle?	Web survey	Positive experiential factors, accessibility by foot & bicycle	Heesch et al (2014); Popovich & Handy (2014); Handy & Clifton (2001)
Frequency of trips, Purpose of visit	Which visit types most frequently bring people to Uptown?	Web survey	Job & service centralization, recreational & purposeful shopping; accessibility by active transport	Santos et al (2010); Bent & Singa (2009); Filion (2009)
Total spent, Most-used travel mode	Do sustainable transport users spend as much as drivers at Uptown?	Web survey, In-person survey	Expenses per visit, monthly expenses	Baker & Macdonald (2006), Clifton et al (2013)
Businesses visited monthly, Most-used travel mode, Distance	Do sustainable transport users use Uptown for more diverse reasons than drivers?	Web survey, In-person survey	Transport mode and errand type	Clifton et al (2013); Handy & Clifton (2001); Turner (2007)

Businesses visited per trip, Most-used travel mode, Distance	Do people trip-chain similarly at Uptown using different travel modes?	Web Survey, In-person survey	Trip chaining by drivers	Baldwin & Fagan (2007)
Primary travel mode, Age	Are younger people more likely to use active transport?	Web Survey	Social dimensions of travel	Jones & Lucas (2012); Popovich & Handy (2014); Butler et al (2007)
Primary travel mode, Income	Is travel mode choice linked to personal income?	Web Survey	Equity and accessibility; access to services	Stanley & Vella-Brodrick (2009); Pucher et al (1999); Martens (2013)
Most-used travel mode, Age	Is travel mode choice linked to age?	Web Survey	Vehicle dependency vs. public and active transit	McIntosh et al (2014); Jones & Lucas (2012)
Most-used travel mode, Census tract median income, CT low-income prevalence, distance	Is travel mode choice linked to neighbourhood affluence?	Web Survey, Census	Residential self-selection and travel preferences, transport wealth & gentrification	Schwanen & Mokhtarian (2005); De Vos et al (2014); Cao, Mokhtarian, & Handy (2009); Dodson et al (2004)
Number of travel modes, Income, Age	Are income or age correlated with more varied use of transport modes?	Web survey	Incentives & disincentives to transport use, transport wealth & poverty	Heesch et al (2014); Jones & Lucas (2012); Stokes & Lucas (2011)
Respondent age & income, Census age & income distributions	Do Uptown shoppers have comparable ages & incomes to the general population?	Web Survey, Census	Sociodemographics of "new middle class"	Bartlett (2003); Quastel et al (2012)
Respondent employment type, census industry distribution	Are Uptown shoppers drawn from particular employment categories?	Web Survey, Census	Beneficiaries of revitalization, "new middle class"	Quastel et al (2012), Meligrana & Skaburskis (2005)
Income, CT median income	Are Uptown shoppers' incomes representative of their neighbourhoods?	Web Survey, Census	Retail & residential gentrification	Meligrana & Skaburskis (2005); Stokes & Lucas (2011); Quastel et al (2012)

Dwelling type, minority status, citizenship, home ownership	Are Uptown shoppers' households representative of their neighbourhoods?	Web Survey, NHS	Social upgrading & residential landscape	Meligrana & Skaburskis (2005), Quastel et al (2012)
Age, gender, citizenship, minority status, income	Do different demographic groups of shopper visit more frequently?	Web Survey, NHS	Inclusivity/exclusivity of core amenities	Martens (2013), Fong (2000)
Reason to Visit, Income	Are people who work at Uptown more affluent than those who visit for other reasons?	Web Survey	Mixed-use centre workers vs. visitors	Luederitz et al (2013); Filion & Bunting (2000)

2. Literature Review

2.1 Overview

An investigation of Uptown's use by the public should take into account its intended complementary functions as a centre for commerce, a social hub, and a node in the city's multi-modal transportation network. To so, this literature review begins with a discussion of the role mixed-use centres play both in land use planning and in urban social geography: the considerations of their placement in the urban landscape, their design and composition, and their utility to their intended users. It then examines how these elements relate to measures of accessibility, detailing the various objective and subjective factors that form the experience of making the trip. These points are then revisited with an emphasis on equity. The potential for these projects to contribute to processes of gentrification are addressed, both through land use patterns and through preferential use by privileged sociodemographic groups. Lastly, the goal of accessibility is weighed against the concept of transport wealth and poverty with a discussion of the links between social demographics and transportation options.

2.2 Retail Space in the Neighbourhood

2.2.1 In Neighbourhood Structure

As previously outlined, discourse regarding the distribution of retail and service spaces throughout the city has considered it on scales from the corner store to the metropolitan commercial core. Visions of the optimal scale, density, location, and heterogeneity of a retailing zone have shifted with social mores and planning objectives, from a post-war glut of suburban malls to a modern-day attempt to reassert the city centre in a multi-nodal city. A common approach in contemporary planning discourse is to consider these different commercial forms as

elements in a hierarchy of areas: a gradient of intensity beginning at integrated block-level retailers for casual trips, then rising through neighbourhood nodes to town and regional centres for a comprehensive range of services (Grant & Perrott, 2010).

The contemporary understanding of these different levels of retailing is shaped by half a century of planning history. In the post-war period of large-scale, car-focused urban renewal projects, Jacobs (1961) exhorted a human scale for retail: a fine-grained distribution of services and shopping spaces within a neighbourhood, dense enough to be conveniently navigable on foot but not so dense as to overwhelm and isolate the resident. Rebelling against the spatial isolation of the suburban shopping mall, her vision of a commercial landscape was subsumed in a community's living environment and inextricably linked to its built space. Its aesthetic appeal and promise of a well-rounded neighbourhood living experience proved inspirational to the New Urbanist and Smart Growth models of development, which have come to present the most coherent counterargument to the mall in distributing commercial spaces.

These movements have adapted traditional commercial designs to contemporary cities with variable success. The corner store, touted as the front line of accessible neighbourhood shopping by the Congress for the New Urbanism (1996) and Smart Growth (Duany & Speck, 2010), struggles to attract a sufficient consumer base when isolated in a lower-density neighbourhood (Bartlett, 2003). For smaller stores to attract an adequate consumer base, they are best grouped with complementary businesses and services (Duany & Speck, 2010; Grant & Perrott, 2010) and incorporated into a more dense environment like a core urban neighbourhood (Turner, 2007). In this way, traditional design elements can be incorporated into larger-scale commercial cores. While in larger cities, cores of this type are dispersed across the urban landscape in a poly-centric development pattern, a smaller city's residents – and transportation network – are better

served by a single business centre (Santos, Behrendt, & Teytelboym, 2010). These centres attract visitors not only through a functional, varied, navigable concentration of businesses; but also by recognizable, attractive design promoting impressions of high-quality service (De Nisco & Warnaby, 2013; Teller & Elms, 2012).

Cores of this nature exhibit traditional design and streetscape features, albeit adapted to a higher density environment. The general principles of complementary services and permeable streetscapes are applicable even to core metropolitan areas (Beasley, 2004), and lend themselves easily to the diverse landscape of a core neighbourhood. The trend towards car-based, chain-focused shopping trips (Handy & Clifton, 2001) is countered by a core neighbourhood ordered around the streetscape, promoting a higher level of activity than a simple mall would support (Bent & Singa, 2009). In contrast to the single destination point represented by a mall, cores of this nature engage the visitor with a distribution of amenities around a focal point: the centre represents the peak of a density gradient in which commercial services cluster in increasing intensity from the surrounding neighbourhood (Clifton et al., 2008). Ideally, a dense, mixed, walkable landscape of this type makes retail and amenities easily accessible to pedestrians, fostering a "live-work-play" environment (Quastel et al., 2012; Sundquist et al., 2011) and attracting multiple heterogeneous user bases (Teller & Elms, 2012). With adequate coordination of the different land uses within the core, it can present an attractive and useful destination point for people arriving by other forms of public and active transportation as well (Filion, 2009), even to the extent of reducing overall personal vehicle use within the city (McIntosh et al., 2014)

Nodes of this nature can be found in both mono- and poly-centric urban systems (Clifton et al., 2008), whether as local growth hubs in a metropolitan area or as smaller city centres. In the context of smaller cities' loss of core services to the periphery (Filion & Hammond, 2008), they

have a noteworthy application: to provide a central retail and service centre with interesting niche markets, supporting a populous core (Filion & Bunting, 2000). Such a neighbourhood provides a convenient local destination for the 70% of daily trips that are not work-related (Turner, 2007), foster a more diverse and locally grounded community (Bramley & Power, 2008), and contribute to a sustainable cityscape by reducing overall travel needs (Luederitz, Lang, & Von Wehrden, 2013). Internally, the dense, mixed-use environment has the potential to present public and quasi-public space as a pedestrian-oriented "people place" (Quastel et al., 2012). Externally, it can provide a hub of public transit, provided the transit network features adequate linkages to the surrounding neighbourhoods (Santos et al., 2010). Although drivers are less influenced by the spatial positioning of centres, they can be drawn by site-specific and site-proximate features (Filion et al., 1999), such as the aesthetic and functional merits of the centre.

2.2.2 Social Considerations

These spaces serve roles in the city beyond their immediate function as spaces of financial transaction. Jacobs (1961) argues that they help to drive the social mechanisms of the city: the time spent shopping or enjoying services is time spent in the company of others, generating opportunities to engage socially. While she stresses the capacity for local stores to strengthen community bonds, they have a broader capacity to support local identities and distinguish subcultures (Jayne, 2006). These businesses then extend the notion of public life past the streetscape, with public and semi-public spaces combining as a theatre of social interaction (Carmona, 2010).

The ramifications of this social role have been explored from several different perspectives. The social construction of place is reflected in the philosophy of performativity: that by making use of a place, people present and develop elements of their social identity.

Florida (2004) relates this philosophical perspective to the planning sphere through the notion of the creative class. Culturally rich, locally distinctive commercial landscapes distinguish themselves through their idiosyncrasies and in so doing, he argues, attract an economically advantageous class of knowledge workers and visionaries (Carter & Bruce, 2003). This concept has not gone unchallenged, although many urban downtowns now promote themselves based on their historical character and their distinct blend of commercial niches (Filion & Hammond, 2008). Of more immediate interest than the utility of the creative class model is the broader matter of how a socially diverse city makes use of these public and quasi-public spaces.

A more humble interpretation of commerce's social worth is that of the Third Place: those businesses that build a local sense of place and identity through regular use. The Third Place is accessible and economical, often offering "sit-down" incentives such as food and drink, and encourage regular patronage that can support friendships and casual acquaintances (Oldenburg, 1999). Furthermore, they offer a neutral, level meeting ground. Spaces like stores, salons, shopping centres, and community facilities can thus serve as focal points for social as well as economic activity, generating value as destinations in their own right above and beyond their immediate function (Jeffres, Bracken, Jian, & Casey, 2009). For example, mixed neighbourhoods incorporating these retail environments provide social support that aids in child care and offers seniors more opportunities to engage socially (Spokane et al., 2007).

2.2.3 Accessibility

Oldenburg's (1999) mention of accessibility raises a major consideration in the design and layout of nodes. It is important to take into account the variety of social and economic groups served by these centres, each with different preferences and capacities in navigating the urban landscape. Accessibility, then, is a relative term, and residents' patterns of consumption and

social engagement are determined in part by how well they can avail themselves of the city's resources (Madanipour, 1998; Santos et al., 2010). For example, a distinct challenge commonly faced by low-income families, the elderly, and youth is transport poverty: factors like limited access to vehicles and personal mobility limit the areas of the city that they can conveniently visit (Stokes & Lucas, 2011). Conversely, strong support of bicycling alleviates transport problems among non-drivers (Martens, 2013). The connectivity, safety, and appeal of the trip to a commercial space is as much or more important than its location relative to potential shoppers' homes (Schwanen & Mokhtarian, 2005; Teller & Elms, 2012), although vehicle-supportive features like parking (Clifton et al., 2013) or transit-supportive investment (Stanley & Vella-Brodrick, 2009) can affect perceived accessibility and resulting use patterns. When a commercial centre is well connected in a way that addresses these potential limiting factors, people arriving by different means show much more equitable shopping habits (Baker & Macdonald, 2006), which is expressed in increased use of sustainable transport methods (Banister, 2011) As hubs of economic and social activity for the city, it then falls to commercial centres to be reachable by multiple dimensions of accessibility.

One core principle in sustainable urban design is the presence of shopping facilities within walking distance, providing for daily retailing needs (Banister, 2011; CNU, 1996; Duany, Plater-Zyberk, & Speck, 2000; Duany & Speck, 2010). Although the archetypal image of walkable retail is perhaps the convenience store or local coffee shop, mid-sized city centres can also enjoy a measure of walkability for residents of core high-density residential areas and inner suburbs. Pedestrian travel is perhaps the most conducive to personal independence, but the trip also engages the traveler most closely to the surrounding landscape. Of all the transportation modes, pedestrian use of a commercial centre is most closely linked to the quality of the trip to the store:

factors like a dangerous arterial crossing or a perceived lack of safety act as more serious disincentives to shop than they do for other modes (Handy & Clifton, 2001). These elements of place and proximity – to wit, site-specific and site-proximate features, independent of the broader urban landscape – have an increased impact on the accessibility of the centre to the immediate neighbourhood (Filion et al., 1999; Teller & Elms, 2012). These experiential factors can compromise the attractiveness of the centre as a destination or enhance its perceived accessibility (Clifton et al., 2013), but are often neglected in planning procedures when the streetscape and integration of land uses are determined (De Vos et al., 2014). When they are addressed in the centre's design, they have the potential to greatly increase the site's amenity and its accessibility to people with mobility restrictions (Baker & Macdonald, 2006).

A second dimension of active transportation has seen considerable scrutiny in recent years: the use of bicycles for leisure, errands, and commutes. Bicyclists occupy a grey area between pedestrians and motor vehicle users in that they enjoy a broader range of access to the city than is practical for foot traffic, but remain an active transport method, with the physical demands that this entails. The general accessibility of different commercial spaces to bicyclists is determined in part by the cyclists' sociodemographic characteristics, which are discussed in later sections; there are, however, trends in bicycle-friendly centres that merit observation. Which business types are observed to constitute a draw factor for bicyclists is inconsistent: some studies have shown a relative preference for local retailers (Baker & Macdonald, 2006), while others found bicyclists to frequent food services disproportionately (Clifton et al., 2013) or to prefer downtown shopping (Bent & Singa, 2009). In general, cycling is seen to lend itself well to a variety of retailing and leisure activities (Millward, Spinney, & Scott, 2013). Bicycle-friendly design and infrastructure features, then, are the most effective means of building cycling

accessibility. Infrastructure supporting active transport includes bicycle lanes and trails, and is observed to increase cycling uptake (Butler, Orpana, & Wiens, 2007). Conversely, bicycling trip frequency is reduced by streetscapes not accommodating bicyclists (Lee, 2008). Bicycling is also discouraged by poor or unsafe network connectivity and a diffuse urban environment (Casello & Rewa, 2011; Heesch, Giles-Corti, & Turrell, 2014). So, while the use of bicycles is demonstrably linked to the quality of supportive infrastructure (Brown, Hawkins, Lahr, & Bodnar, 2014), its infrastructural demands are relatively modest, and lend themselves well to many of the businesses that are found in a mid-sized centre.

Use of public transit to reach a commercial centre is especially situational, given that the choice of routes and frequency of service is determined by a central authority. As such, accessibility via public transit is heavily influenced by the level of investment in the public transit system, to the extent that it is a major determinant in the use of shopping nodes (Filion, 2009). Patterns of transit connectivity through the city must also be taken into consideration. Public transit users have a marked dependence on the urban centre relative to other transit modes (Baker & Macdonald, 2006), whereas less dense, transit-poorer suburban centres offer less incentive to use (Bunting et al., 2007). Beyond the borders of the centre, neighbourhoods require adequate public transit service for their residents to make use of it to visit any node (Curl et al., 2011; Filion, 2009). Public transit use is a key potential driver of sustainable development (Bagley & Mokhtarian, 2002) and does generally succeed in drawing users to the central city (Baker & Macdonald, 2006), but its overall utility is highly situational due to the local decisions governing its level of service. In particular, overall integration with a multimodal transportation network is also highly conducive to bicycling uptake (Santos et al., 2010).

In American and, to a lesser extent, Canadian cities, low-density patterns of urban development both assume and reinforce personal vehicle use (Kenworthy & Laube, 1999). Car-focused urban streetscapes have served to divorce the notion of accessibility from the commercial centre's location relative to residential areas: instead, shoppers are drawn by features internal to the site, often informed by personal attitudes and travel habits (P. Jones & Lucas, 2012). Even time-consuming factors like congested roadways provide only minimal disincentive to personal vehicle use (Baker & Macdonald, 2006; Clifton et al., 2013), suggesting that the experience of shopping at the site is distanced from the experience of travelling to and from the centre. An implication of this finding is that traffic calming design features, while increasing road network friendliness to cyclists and pedestrians (McIntosh et al., 2014), do not deter drivers from using the roadways. One exception to the rule is parking: limited free parking availability markedly limits the use of the commercial node (Santos et al., 2010). This is likely due to the frustration of searching for a parking space acting as a negative experiential factor, the like of which can motivate a potential shopper to choose a more distant commercial space instead (Clifton et al., 2013).

2.2.4 Shopping Patterns

In general, a commercial node must offer a broad variety of activity options – from staple shopping and food services to more specialized stores – for it to be an attractive destination to a broad consumer base (Filion, 2009). Though Florida's vision of varied specialty shopping serves to build a local brand, for the commercial centre to be useful to a diverse urban population, these niche functions must be supplemented by the staples that often serve as anchor businesses. In particular, food stores of any variety are a primary choice of destination for all social and transit groups (Handy & Clifton, 2001), enjoying consistent and frequent patronage from shoppers of all

neighbourhood types. Food shopping and other forms of convenience shopping generate relatively frequent, mostly unplanned trips (Clifton et al., 2013).

A pertinent distinction is that between hedonic and utilitarian activities: shopping for personal enjoyment or for a specific purpose. Either strategy or both can be served by a single shopping centre (Allard, Babin, & Chebat, 2009), and the two are not mutually exclusive even on a single trip. Customers might shop hedonically for the sake of novelty, bargain-hunting, self-reward, social engagement, or other values (Arnold & Reynolds, 2003), and might incorporate hedonic elements into an otherwise utilitarian excursion (Yim, Yoo, Sauer, & Seo, 2013). This shopping behaviour is more subjective and personal than utilitarian shopping (Allard et al., 2009), but is a valuable expression of a shopping centre's amenity value to the surrounding neighbourhood, and plays an important role in establishing the centre's good reputation (M. A. Jones, Reynolds, & Arnold, 2006).

Accounting for transportation choice, there is a general trend for higher-income shoppers to be more commercially active. Total retail expenses are directly correlated to household income (Bartlett, 2003), though the degree of influence may be small (Clifton et al., 2013) Higher-income households also tend to make longer trips, even when walking or bicycling, than lower-income households (Pucher & Renne, 2003), which could indicate more recreational travel or a willingness to go farther to reach desirable shopping facilities (Handy & Clifton, 2001).

The relationship between spending behaviour and travel mode is uncertain (Popovich & Handy, 2014), but research suggests that users of active and public transport spend more or less as much as drivers, if perhaps in different patterns. With the influence of income removed, drivers and non-drivers have similar total expenses, particularly at local centres and convenience shopping (Baker & Macdonald, 2006); in that capacity, cyclists have been observed to spend the

most per person-month despite spending the least per visit, and convenience shopping also attracts a high share of pedestrians (Clifton et al., 2013). The breakdown of different trip types (e.g. leisure, shopping, etc.) proved largely equivalent across travel modes (Stokes & Lucas, 2011). Although there is disagreement as to whether cyclists spend as much as drivers or less per trip, there is a general consensus that active transport brings more frequent use of core shopping facilities, as well as a greater variety of shopping activities, for equivalent or greater total expenses (Baker & Macdonald, 2006; Clifton et al., 2013; Popovich & Handy, 2014).

2.3 Urban Revitalization and Social Upgrading

That a revitalization effort should increase the wealth of a neighbourhood is unsurprising; a disadvantage of this process is that it often comes at the expense of the poor. Centralized densification and development reverses a general post-war drift towards the margins of the city (Bunting et al., 2007), with a particular focus on neighbourhoods near the central business district with older homes, diverse housing stock, and higher building density; in short, former working-class areas (Meligrana & Skaburskis, 2005). Revitalization initiatives targeted at central-city growth and intensification, notably Smart Growth-informed ones (Quastel, 2013) have a marked tendency to raise adjacent land values from below-average to above, drawing in residents of the "new middle class" while pricing existing residents out of the market (Quastel et al., 2012).

One driver of this process is that the form-based, service-conscious development pattern favourable to revitalization schemes is as marketable in the real estate business as in the city council (Luederitz et al., 2013). Mixed-use, intensified development naturally boosts property values (Koster & Rouwendal, 2012), since a diverse and interesting residential neighbourhood with easy access to the amenities of the downtown core is extremely desirable to affluent

members of the knowledge economy (Bayoh, 2004; Moos, Wilkin, Chase, & Seasons, 2015). These "interesting" older neighbourhoods can be marketed at a premium (Meligrana & Skaburskis, 2005), as can the unique street culture and niche appeal of the revitalized area in contrast with a homogeneous suburb (Ley & Dobson, 2008). Consequently, they are targeted by high-income urban professionals, whose tastes for downtown culture and entertainment, heritage homes, and a nearby workplace (Filion & Bunting, 2000) bring greater purchasing power to bear on these niche areas .

As such, although downtown improvement plans are often introduced as part of a sustainable development initiative, the urban forms they generate are most favourable to those who already enjoy privilege. The "sustainability-as-density" model encourages walkable, mixed-use core areas with high-density living space and service for transit corridors (Quastel et al., 2012), a highly desirable urban form for the sprawl-opposed (Turner, 2007) and a development pattern conducive to the success of its retail nodes (Clifton et al., 2008; Filion, 2009). That boost in density is directly correlated with a reduction in affordability, both by total cost and as a proportion of renters' incomes (T. A. Clark, 2013); they also boost the hedonic value of houses in the retail catchment area (Song & Knaap, 2004). That catchment area disproportionately includes poorer areas (Pucher & Renne, 2003).

There are reasonably consistent patterns in the residential groups that result. As the housing market polarizes the social landscape (Dodson, Gleeson, & Sipe, 2004), the composition of gentrifying regions shifts towards smaller, better educated, more mobile, and often younger households (Meligrana & Skaburskis, 2005). The condominiums of the urban core are particularly attractive to the young (though also to those of late middle age), educated, and affluent (Filion & Bunting, 2000). This creates an optimal landscape for a "new middle class"

dominated by business, the arts and social sciences, and government workers, particularly among high-income young adults (Carter & Bruce, 2003; Quastel et al., 2012). Conversely, visible minorities (Fong, 2000), single-parent households (Stokes & Lucas, 2011), service workers (Quastel et al., 2012), and renters (T. A. Clark, 2013) tend to be most disadvantaged by revitalization. These trends reinforce themselves until the housing market reaches an equilibrium at a higher mean income (Bayoh, 2004). Given the public investment and branding value involved in projects to revitalize the urban core, a degree of gentrification is to be expected. However, the displacement of the disadvantaged (Meligrana & Skaburskis, 2005), particularly minority groups (Fong, 2000), defies the usual policy goal that these new core spaces be accessible and equitable.

2.4 Transport Wealth and Eco-Gentrification

A second discourse in accessibility exists alongside the spatially bounded demographic shifts of conventional gentrification. The general notion of transportation wealth and poverty takes into account the availability of different forms of transport to the city's sociodemographic groups, asking how much investment and effort is required for them to reach vital destinations and avail themselves of the city's services. The concept is currently nebulously defined, comprising subjective measures of satisfaction and amenity with objective indices of transport availability, transport affordability, and density of services (Stokes & Lucas, 2011); but it addresses the attitudinal and sociodemographic elements of accessibility (Bagley & Mokhtarian, 2002) in a way that isolated measures of spatial proximity (Curl et al., 2011) and neighbourhood structure (Curl et al., 2011) do not. Given that the poor are generally prone to transport poverty (P. Jones & Lucas, 2012; Stokes & Lucas, 2011) despite not being as starkly spatially segregated in Canadian cities (Fong, 2000), it is worthwhile to address this element of accessibility.

Differential transport wealth is also one of the factors linking economic wellbeing to social and environmental sustainability. Overarching the structural goals of land use heterogeneity and density is a general goal to reduce "gaps in sufficiency and opportunity" between different social groups (Luederitz et al., 2013); one key measure of this aspect of sustainable development is the ease of mobility those groups enjoy. There are currently marked sociodemographic trends in transport poverty to illustrate this fact. Car-oriented land use patterns common in modern cities marginalize those groups who do not have easy access to a personal vehicle (Filion et al., 1999; Stanley & Vella-Brodrick, 2009), imposing a dependence on public transit even when the urban layout or transport network might make its use impractical (McIntosh et al., 2014; Souche, 2010). Transport disadvantage and the social exclusion that ensues are disproportionately suffered by low-income and unemployed people, children, the elderly, and ethnic minorities, as well as residents of transport-poor outer-city areas (Dodson et al., 2004). Conventional measures of gentrification do not account for this gap in accessibility. Indeed, the diffuse structure of modern cities exhibit dispersed areas of "potential gentrification" (Meligrana & Skaburskis, 2005), whose residents' composition and activities are determined more by their interests and preferences than the neighbourhood's structure or location (Schwanen & Mokhtarian, 2005), suggesting that internal and sociodemographic factors have a greater influence on the matter than any discrete zone of gentrification.

As mentioned, a close correlation exists between economic hardship and transport poverty. The lowest income group is over twice as likely as the highest not to have easy access to any transportation, whereas the most affluent are half again as likely as the low-income to have easy access to multiple transportation modes (Stokes & Lucas, 2011). Additionally, high-income households make more trips and travel more miles (Pucher & Renne, 2003) than lower income

groups, suggesting a broader use of urban amenities, in direct contrast with the social and economic exclusion inflicted by accessibility problems (Martens, 2013). One core factor in this correlation is vehicle ownership. Lower-income households are much less likely than the affluent to own a vehicle, and vehicle ownership inflicts a greater financial burden on them (Stokes & Lucas, 2011), but the lack of other options can force low-income households into purchasing personal vehicles nonetheless (Dodson et al., 2004). This is demonstrated by the reliance of already disadvantaged social groups on private vehicles, particularly in areas that are not well served by transit (Pucher & Renne, 2003). Depending on up-front costs and availability, public transit can be an untenable option for disadvantaged households (Souche, 2010; Stanley & Vella-Brodrick, 2009), exacerbating the state of transit poverty.

There is a locational element to transport disadvantage, although the relationship is not as clear-cut as indicators of core gentrification would suggest. Economically deprived areas generally suffer from a greater degree of transport poverty (Stokes & Lucas, 2011), whereas gentrifying areas enjoy greater mobility (Meligrana & Skaburskis, 2005) and transport diversity (Pucher & Renne, 2003); however, overall neighbourhood deprivation is a less reliable indicator of transport poverty than the income status of the household itself (Stokes & Lucas, 2011). One potential explanation is the generally low density gradient and decentralization of the car-oriented modern city. Transportation options other than the personal vehicle become less tenable in a highly dispersed city, making it difficult to reduce reliance on personal vehicles (Filion et al., 1999). This poses a challenge in promoting equitable transport wealth, since low-income groups have come to be more dispersed throughout the metropolitan area: the concentration of poverty in inner-city areas is being replaced by fine-grained, tightly clustered areas of deprivation distributed across the suburban landscape (Ades, Apparicio, & Seguin, 2012). This

provides insight into the general trend that growth management mitigates transport poverty while sprawl exacerbates it (Martens, 2013), illustrating the differential impact of development patterns on various social groups.

Short of large-scale urban restructuring, public transit investment is perhaps the most straightforward means of compensating for transport poverty. An accessible, well-integrated public transit system mitigates the effects of space-based social disadvantage and exclusion (Dodson et al., 2004; Santos et al., 2010), despite inducing a relative reliance on core areas (Baker & Macdonald, 2006), and should be available to all social strata in a sustainable urban landscape (Luederitz et al., 2013). Conversely, lack of access to transit is a key locational disadvantage in determining transport poverty (Dodson et al., 2004). Inner urban areas suffering from deprivation already enjoy relatively broad access to public transit as measured by proximity of bus stops and frequency of service (Stokes & Lucas, 2011). The new dispersion of poverty into car-focused suburban neighbourhoods (Ades et al., 2012) complicates this trend and impedes the alleviation of transport poverty: transit use among low-income households is declining as areas of poverty distribute more broadly across the city, impeding access to bus and rail services (Pucher & Renne, 2003). The internal structure of these suburban landscapes can discourage non-car travel irrespective of personal preferences (Cao, Mokhtarian, & Handy, 2009), and low-income households enjoy less freedom to select a neighbourhood more in line with those preferences (Duke, 1998).

Promoting active transport methods has been touted as a means of reducing transport poverty (Martens, 2013), but initiatives to that end must take into consideration the existing structure of the neighbourhood and the demographics of its residents. Certainly, a more walkable neighbourhood is associated with a dramatic increase both in the proportion of trips

made on foot and the distance traveled (Sundquist et al., 2011), and can even encourage walking in those who might not otherwise (Cao et al., 2009). However, walkability and accessibility owe as much to the proximity of amenities (Filion et al., 1999; Stokes & Lucas, 2011) as to streetscape design, and those with reduced personal mobility have their walking and bicycling range curtailed (Pucher & Renne, 2003). As such, while neighbourhoods with infrastructure supportive of active transport provide increased mobility to low-income groups, those who benefit most are the younger, physically active individuals who tend to cycle most already (Butler et al., 2007; Popovich & Handy, 2014).

As a means of opening up access to the city, then, bicycling has an uncertain role in alleviating transport poverty. Those who experience transport poverty do use bicycles for a larger proportion of trips, but do not otherwise exhibit different travel behaviours from those who have other options available; in particular, they show no tendency to make longer trips, making the utility of bicycles dependent on the accessibility of destinations (Martens, 2013). Bicycle use is largely evenly distributed across the income range (Pucher & Renne, 2003), is a popular choice among lower-income groups and neighbourhoods (Heesch et al., 2014; Popovich & Handy, 2014; Pucher, Komano, & Schimek, 1999), and is used as an alternative to personal vehicles even in some high-income households (Casello & Rewa, 2011; Stokes & Lucas, 2011). With car use rising in low-income households (Stokes & Lucas, 2011), the capacity of the bicycle to increase transport wealth in the financially poor must be re-evaluated.

In addition to their ramifications for disadvantaged groups, the effects of these trends on environmental initiatives must be considered. Revitalization efforts have increased public transit use among the wealthy, thanks in part to the gentrification of inner-city and inner suburban neighbourhoods that formerly housed the working class (Pucher & Renne, 2003); however, this

has come at the expense of denying those services to the poor. Consequently, while car use in high-income households has fallen, it is rising in low-income households (Stokes & Lucas, 2011), offsetting the capacity of revitalization schemes to reduce emissions. Opinion is divided on whether cycling-supportive infrastructure benefits low-income groups (Butler et al., 2007) or the higher-income groups who already enjoy a variety of transport options (Sustainable Development Commission, 2011). In the latter case, a form of eco-gentrification is seen, where environmentally friendly transportation is facilitated for those who can elect to enjoy it, but not for those who would use it out of necessity.

3. Methods

3.1 Data Collection

Data on Uptown shoppers were collected in two primary ways: an in-person survey administered to passers-by in Uptown, and an online survey promoted through social and other media. Through this, a profile of the demography of Uptown shoppers was constructed and compared to the shopping practices reported. This data set is previously featured in Moos, Casello, Chase, & Lanoue (2015).

The primary purpose of the in-person survey was to characterise the shopping behaviour of people visiting Uptown by various modes of transportation, in particular which businesses were frequented and how much money people spent per trip (ref. Appendix A). As such, a quota was established of 100 participants per transportation method: walking, bicycling, arriving in a personal vehicle, and taking public transit. The survey was administered via tablet by two University of Waterloo research assistants over a nine-day period, May 20-28 2014. Wearing University t-shirts, they circulated through Uptown, focusing on the King Street corridor in the vicinity of Waterloo Town Square. With adjacent parking lots and garages, easy access to the Laurel Trail through Waterloo Park, multiple bicycle lock-ups (both rented and free), and bus stops for the mainline and express routes, this was a key location for recruiting participants from all modes of transportation. Points at which the survey was administered to volunteers are marked in Figure 2.

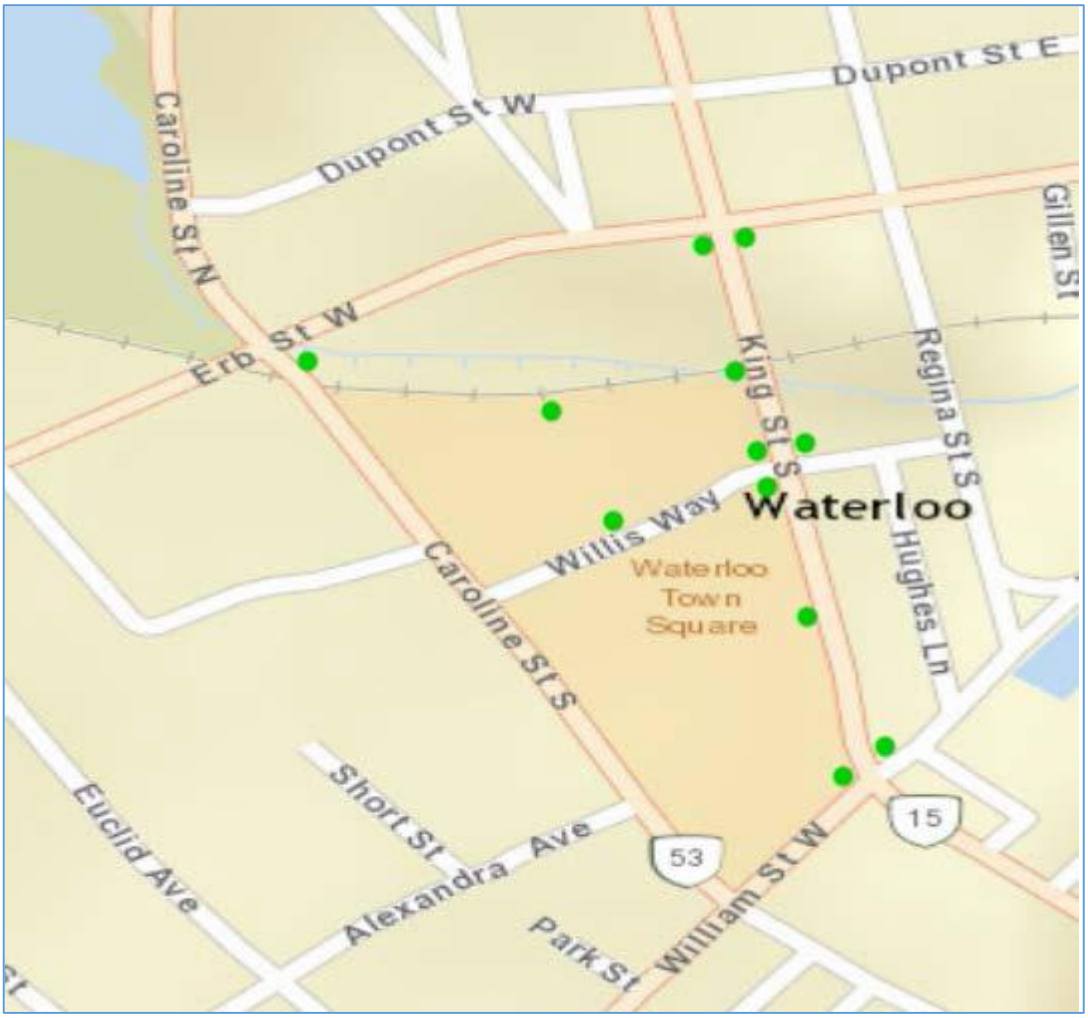

Figure 2: Locations at which in-person surveys were administered by volunteer pair. Reprinted from Moos, Casello, Chase, & Lanoue 2015

During the nine-day data collection period, the research assistants circulated between the hours of 10:30am and 12:30pm, and later in the afternoon from 3:30pm to 5:30pm. The primary goal in this exercise was to gather sufficient responses from each mode of transportation to compare their users' shopping patterns meaningfully. Given this method, the respondents are not statistically representative of Uptown shoppers as a whole, but no feasible means of taking a random sample of shoppers was available. No particular selection criteria for potential participants were employed, aside from their walking speed, engagement in conversation, and

the assiduity with which they avoided eye contact. In total, 424 responses were obtained: 101 bicyclists, 109 drivers of personal vehicles, 102 public transit passengers, 109 people who walked, and three who arrived by other means.

The web survey was designed with the goal of extrapolating from individual shopping trips to overall shopping habits and linking those trends to shoppers' demographics. It evaluates the purchasing power of different social groups in greater detail and explores how that power is exercised in Uptown (ref. Appendix B). The survey was hosted on the FluidSurveys platform, a freely accessible web service, and accessed via a publicly available URL. Researchers' social media accounts, followed on Twitter by approximately 600 people, were the primary means of spreading awareness and access to the survey. Retweets during the survey period caused the survey link to be promoted by fourteen Twitter accounts overall, with a combined pool of approximately 20 000 unique followers as of November 2014, 3649 of whom confirmed their locations as being within Kitchener or Waterloo.

To augment the web promotion, a K-W CBC radio interview was conducted while the survey was open, during which the project was described and the link provided. An advertisement and invitation to participate were also added to an e-newsletter released by the City on matters of transportation. Lastly, a Region of Waterloo e-newsletter included a link to the survey; out of the 4500 recipients on the mailing list, 30 clicked through to the survey.

The survey was made available to participation on August 8, 2014, and was closed on September 18. It is unknown how many people viewed the splash page to the survey, but 324 people clicked through the introductory and privacy statements to view the survey itself. Of those, 227 complete responses were received; participants who began the survey but did not click the "Submit" button at its end had their participation logged as incomplete, and the answers to

partially completed surveys were not saved based on the assurance that participation could be withdrawn at any time.

3.2 Data Analysis

For the web survey, blank responses were discarded; all other responses were entirely complete or omitted answers to at most two questions. The only notable non-response rate was 11.7% for the question on total individual income, with other questions at 1% or less.

In order to situate the survey respondents relative to Uptown, a map of the spatial distribution of the Census Metropolitan Area's postal codes was added to ArcMap. The centroids of the postal codes' areas were calculated and joined to the respondents' postal codes as provided in the web survey. The centre of Waterloo Town Square was added to the data set and the distance from each centroid to the Square calculated. Straight-line distances are used both to avoid potential differences in travel route related to travel mode and due to their use in calculating accessibility scores by foot and bus (Duncan, Aldstadt, Whalen, & Melly, 2012).

Participants in the online survey ranged in point of origin from the Uptown census tract (within 300m) to London and Hamilton. While the presence of out-of-town shoppers is an interesting subject that merits further investigation, respondents situated outside the Kitchener-Waterloo-Cambridge Census Metropolitan Area (as delineated in Figure 3) were not considered for the purposes of this thesis, so as to focus on the use of Uptown's facilities by local residents and the site's interaction with its surrounding neighbourhoods. Twenty-one such responses were removed, leaving a total sample size of 206 in-town survey participants.

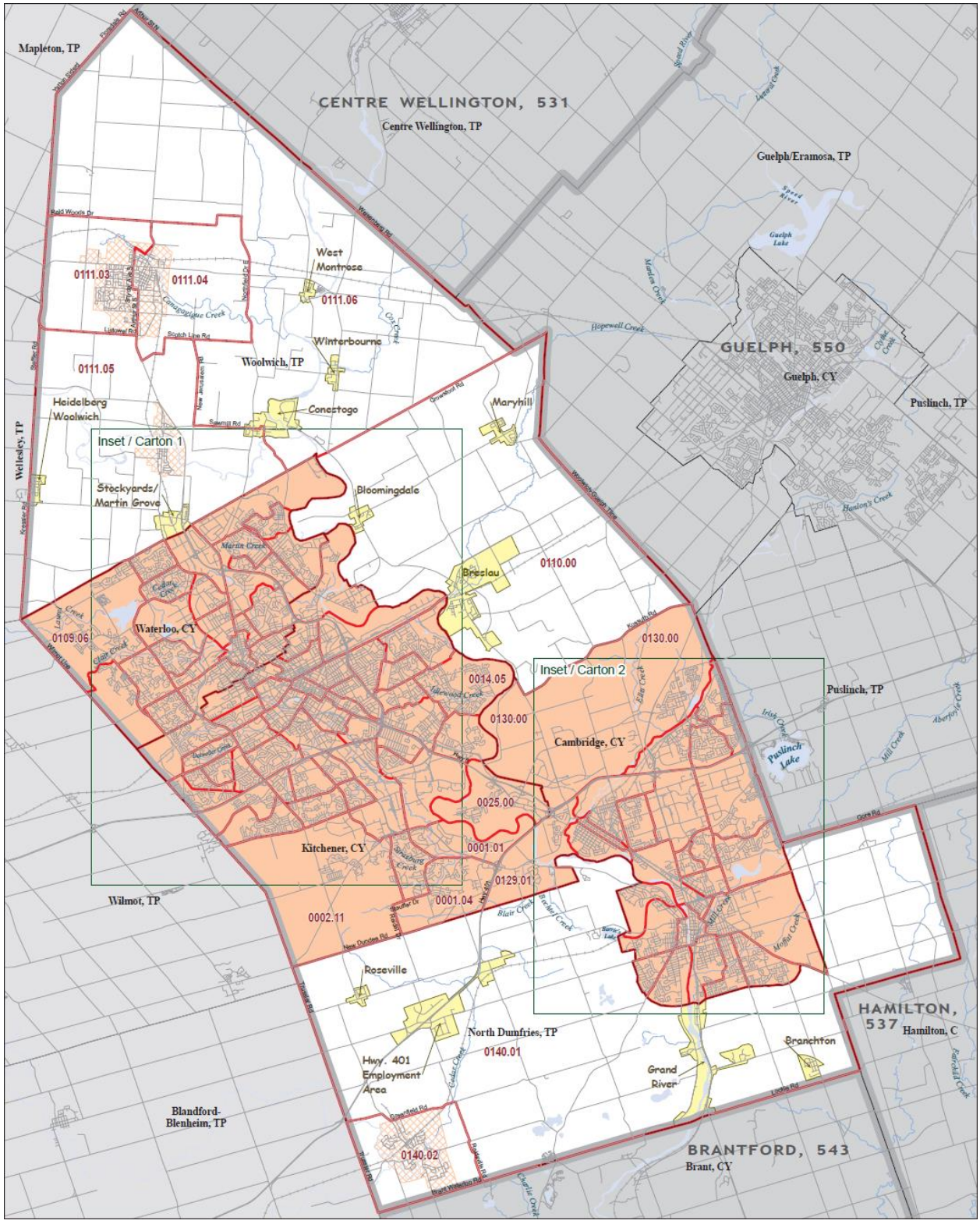

Figure 3: Boundary of Kitchener-Waterloo-Cambridge Census Metropolitan Area

(In white and pink) (Statistics Canada, 2011)

In order to compare the demography of survey participants to the trends in their neighbourhood and in the Census Metropolitan Area as a whole, the results of the 2011 Statistics Canada Census of Population and 2011 National Household Survey were used. Summary statistics related to respondents' host census tract, the census tract containing Uptown, and the Kitchener-Waterloo-Cambridge Census Metropolitan Area refer to data aggregated at the Census Tract level. To associate survey participants with a census tract, the geocoded centroids of the survey responses were overlaid on the map of census tracts. Each survey response was joined to the NHS and census data of the census tract containing that centroid.

Some census tracts contain multiple postal codes and vice versa, while some postal codes overlap multiple census tracts. In those cases, particularly in peripheral areas where postal codes cover exceptionally large geographical areas, the centroid of the postal code is not necessarily an accurate means of determining the precise location of the home. This does, however, provide a general means of estimating the demographic traits of the survey respondents' neighbourhoods. Also of note is that the National Household Survey does not require participation, like the census does. The non-response rate in the Kitchener-Waterloo-Cambridge Census Metropolitan Area was 23.4% in 2011, a potential source of bias.

Statistical analysis of the findings is performed through several parametric and non-parametric tests. In the case of interval variables (e.g. total expenses at Uptown), the Shapiro-Wilk test is used to determine whether the results are normally distributed. Non-normally distributed subpopulations (e.g. total expenses, grouped by preferred travel mode) are compared using the Kruskal-Wallis Test, while normally distributed subpopulations are compared using the Analysis of Variance. In both cases, a lower *p*-value signifies a low probability that the differences observed in those sub-populations are due to chance, suggesting instead that the

breakdown of subpopulations is itself an influence (e.g. that different total expenses are associated with different travel modes). P-values of 0.05 or below are generally held to be the threshold of statistical significance. In some cases, this relationship is tested with linear models, which express one dependent variable as an arithmetic function of some independent variable. In addition to the p-value, an r^2 value between 0 and 1 denotes the predictive capacity of the model. Lastly, relationships between two categorical variables (e.g. between respondents' housing type and preferred travel mode) are examined for significance with the Pearson's χ^2 test.

4. Findings

4.1 Does Uptown support sustainable transport?

4.1.1 How do people reach Uptown?

- *Proportion of visitors by top (most-used) travel mode*
- *Top travel mode vs. proportion of trips made by top mode*
- *Distance from home postal code to Uptown by top mode*
- *Travel time to Uptown by travel mode*

4.1.1.1 What travel modes?

In contrast to the transportation method they preferred for overall use, participants were asked how many times in an average month they visited Uptown using each of the four main methods of travel. The mode by which the most trips were made was designated their "top mode". By this measurement, the participants' preference for active transport is highlighted, as illustrated in Figure 4. A 35.6% plurality of respondents most frequently traveled to Uptown by bicycle, while 27.3% did so on foot. With 27.8% of participants, driving fell to the second-most popular means of reaching Uptown, on par with foot traffic. A reduced number of participants used public transit to reach Uptown: 9.3%, compared to the 14.1% who used it as a primary mode.

This speaks very well to Uptown's goal of a pedestrian-friendly, accessible streetscape, as well as to its bicycle infrastructure. Even taking into account the potential for bias from the data collection methods, a majority use of sustainable transportation methods among the participants indicates a trend away from personal vehicles as the city continues to develop its commercial core. The reduced number of public transit users, however, suggests that Uptown does not draw them as strongly as it could. Public transit users are generally highly represented among shoppers in core areas (Baker & Macdonald, 2006); while their representation among the

participants is above the CMA average, the fact that fewer participants bus to Uptown than bus in general could be a sign of accessibility issues, but its high degree of connectivity suggests that that demographic is less well served by Uptown's amenities. Alternatively, those who might take the bus to Uptown could find bicycling a more pleasant travel option; given the association of active transport with more frequent and more recreational trips (Bent & Singa, 2009; Clifton et al., 2013; Popovich & Handy, 2014).

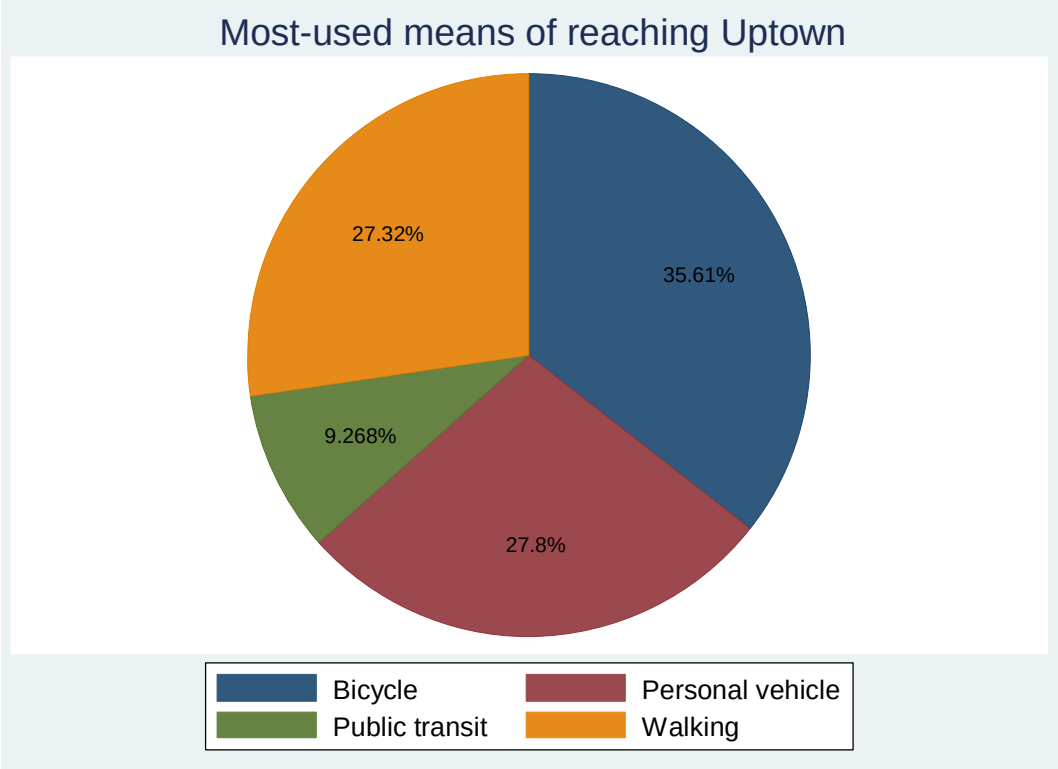

Figure 4: Top travel mode in reaching Uptown (web survey, n=206)

Uptown appears to be an accessible destination via active transportation even to those who otherwise do not use it. Those who listed personal vehicles or public transit as their primary

mode of transportation had a marked tendency to use active transport to reach Uptown: 55.1% of primary bus passengers and 65.8% of drivers most frequently used their primary transit methods when shopping at Uptown, compared to 74.4% of pedestrians and 80.0% of bicyclists. Of the former group, neither travels to uptown using the other transportation mode with any notable frequency; instead, primary drivers bicycle and walk in equal measure, while 17.2% of primary bus passengers bicycle to Uptown and 24.1% walk. Primary pedestrians who do not most frequently walk to Uptown instead bicycled or drove in equal numbers, perhaps for faster access or easier carrying of purchases. Primary bicyclists were least likely to use alternative transportation methods, and a majority of those who did walked instead. This corroborates previous evidence that availability of motor vehicles does not strongly reduce bicycling (Popovich & Handy, 2014)

4.1.1.2 Compared to point of origin?

As one might expect, there is very strong evidence (Kruskal-Wallis $p=0.0001$) that the distance from Uptown to respondents' homes informs their choice of travel mode. The distribution of distances is highly irregular both overall (Shapiro-Wilk $p\approx 0$) and within each most frequently used transportation mode (Shapiro-Wilk $p<0.004$ for all), skewing heavily towards longer distances. Distance is determined by a straight line from Waterloo Town Square to the centroid of the area of the respondents' postal code. The median straight-line distance for Uptown shoppers is 2.38km, with an interquartile range of 1.13km-3.63km, though much longer trips are not uncommon, as illustrated in Figure 5.

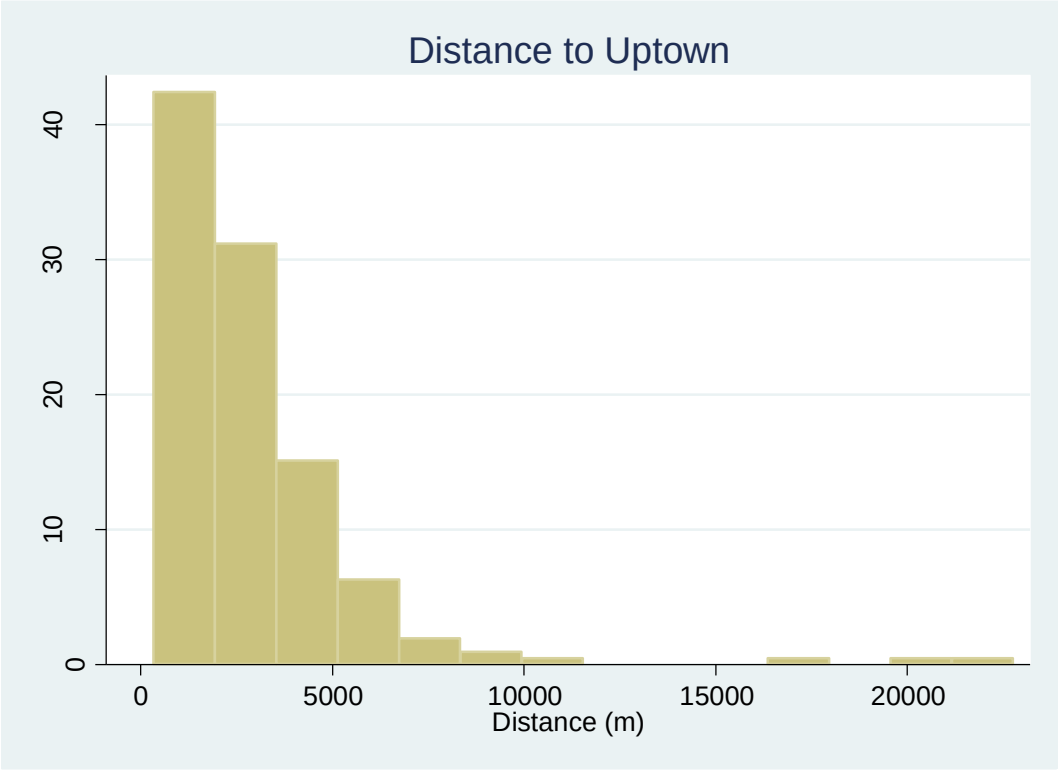

Figure 5: Distance from respondent home postal code to Uptown (web survey, n=206)

Of those who most often walk to Uptown, the median distance was substantially shorter at 0.76km. Interestingly, this approximates the 800m ten-minute walk used as a standard measure of accessibility by foot and of general neighbourhood walkability (Duncan et al., 2012). A majority of pedestrians walked between 0.53km and 1.43km, with a 95th percentile at 3.29km (see Figure 6); effectively, Uptown is primarily a pedestrian destination for those living adjacent or near by it.

The travel patterns of bicyclists were closest to the overall distribution: a median of 2.4km, with an interquartile range of 1.56km-3.6km. They also showed the least skewed distribution of the different transportation modes (Fig. 6), with a more even use relative to distance than even drivers showed. While bicycling is an impractical option for those with mobility restrictions,

among those without, it can serve both as a means of travel and a leisure activity in and of itself, making longer bicycle trips a more appealing travel choice than the travel distance suggests.

Public transit was used less at above-average distances than one might expect. With a median travel distance of 2.62km (Fig. 6), it occupies a middle ground between bicycling and personal vehicles, but the interquartile range of 1.96km-3.16km is clustered more towards shorter distances than bicyclists, a trend that becomes more pronounced at even longer distances. At short distances, public transit use is overshadowed by foot travel. At longer distances, presumably, the possibility grows that the bus connections in the participants' neighbourhood are lacking or do not provide a convenient transfer to a line accessing Uptown. In the peripheral areas of town, there might be little or no bus access, which can force vehicle use among groups who would otherwise prefer to bus (Dodson et al., 2004).

Personal vehicle users were, of course, the most mobile of the survey participants. A majority of them live between 2.85km and 4.98km away, with a median distance of 3.7km (Fig. 6). They were also the most skewed of the distributions towards longer trips. That the personal vehicle is the favoured option for people coming from great distances is unsurprising: with good roadways, the distance traveled to an amenity is relatively unimportant compared to that amenity's features (Filion et al., 1999). Another factor of influence is the potential difficulty of carrying purchases on a bicycle and the greater ease with which one can drive the distance. These factors notwithstanding, bicyclists retained sizeable minority representation among travelers even at longer commutes. Of the 51 survey participants who traveled more than 3.6km, the third quartile of overall trips, 33.3% came by bicycle; this proportion rises to 38.5% of those who travel from more than 5km away. At that distance, other shopping options are at least as

accessible; those who travel to Uptown anyway presumably do so at least partially for the pleasure of the trip.

Pairwise comparison of the distributions of travel distances according to most-used travel mode find statistically significant distinctions between all means of transportation except between bicycling and public transit. There is very strong evidence that pedestrians have a distinct spatial distribution from public transit users (Kruskal-Wallis $p=0.0001$) and from bicyclists ($p=0.0001$), and that public transit users ($p=0.001$) and bicyclists ($p=0.0001$) are distinct from personal vehicle users. There is, however, little to no evidence that bicyclists and public transit users ($p=0.77$) are traveling different distances. Given the availability of bicycle racks on most city buses, there is likely overlap between the two groups. These gaps in average transit length are consistent with those in other cities (Clifton et al., 2013), although Uptown's public transit use trails off more sharply at greater distances than in other comparable areas. The overall spatial distribution of respondents by their preferred means of reaching Uptown is illustrated in Figure 8.

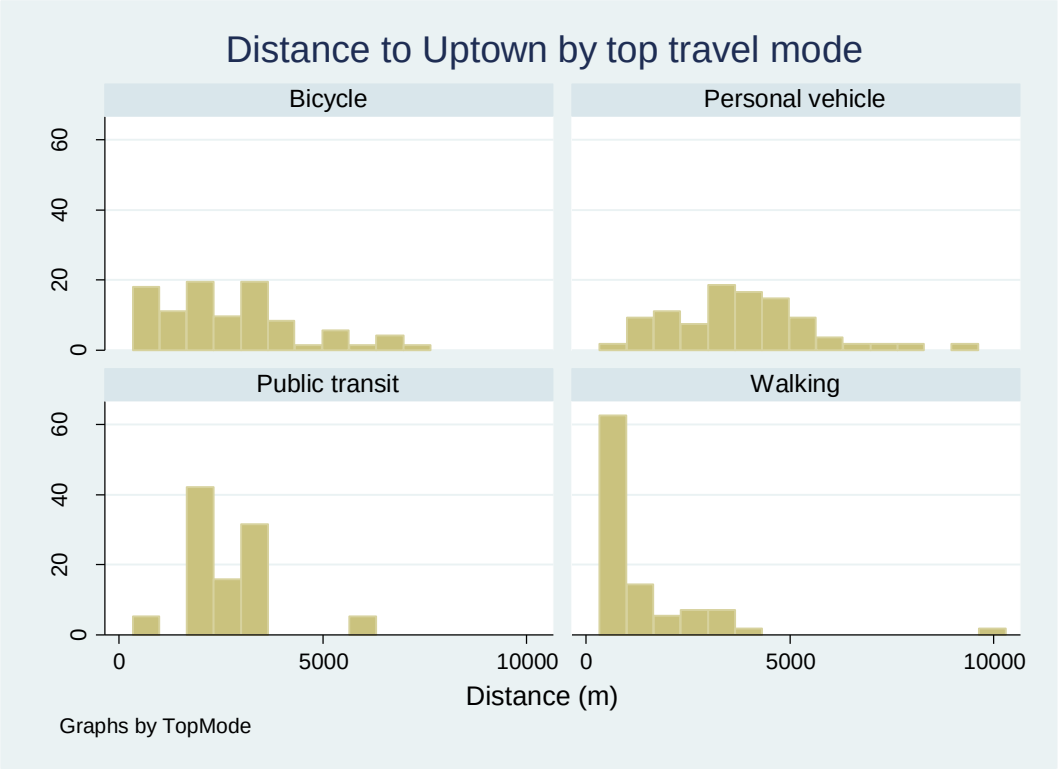

Figure 6: Histograms of distance from home postal code by most-used travel mode (Web survey, nBicycle=73, nVehicle=53, nTransit=19, nWalk=56) (Not shown: four drivers whose travel distance varied from 10km to 22km.)

While travel distance is heavily influenced by top travel mode, the differences in travel time are much smaller. All travel time distributions from the in-person survey are irregular (Shapiro-Wilk $p \approx 0$ for all); a non-parametric comparison finds moderate evidence of a distinction in travel time (Kruskal-Wallis $p=0.084$), though the greatest difference in median travel time was between 10 minutes for drivers and 13.5 minutes for public transit users (See Figure 7).

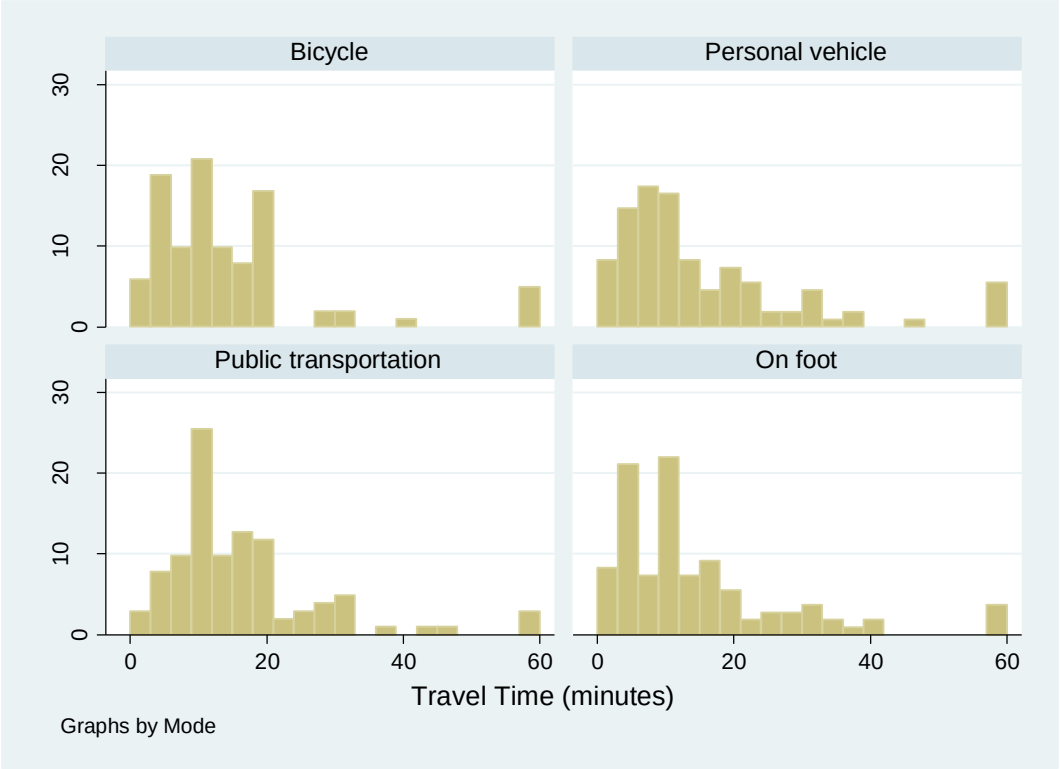

Figure 7: Histograms of travel time to Uptown on current trip (In-person survey, nBicycle=101, nVehicle=109, nTransit=102, nFoot=109)

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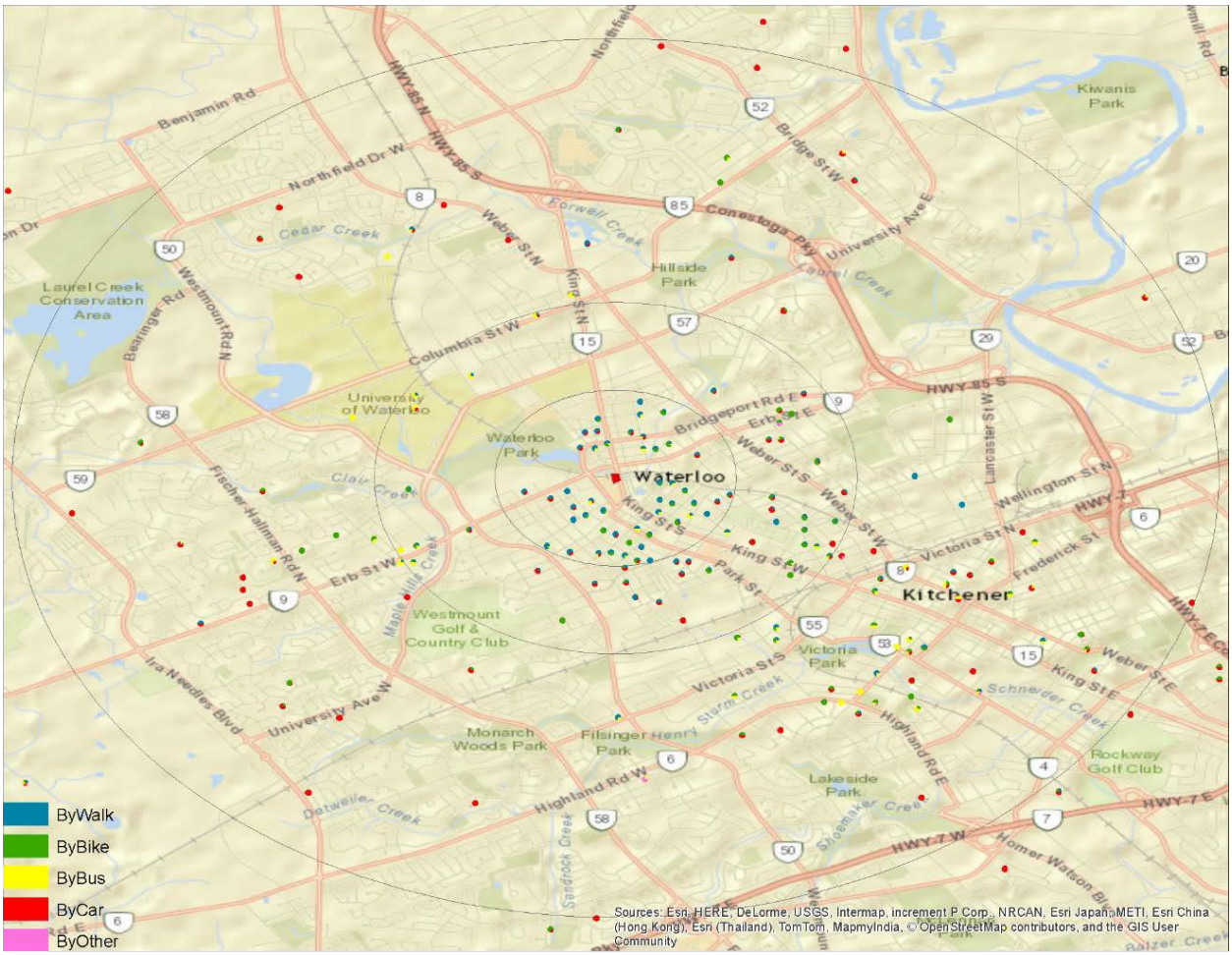

Figure 8: Survey respondents within ~5km of Uptown, by most-used means of reaching Uptown

(Web survey, n=189. Not pictured: six bicyclists, 10 drivers, 1 public transit user.)

Previously printed in Moos, Casello, Chase, & Lanoue (2015)

4.1.2 How often do they come?

- *Total monthly visits to Uptown by top mode*
- *Monthly visits to Uptown made with top mode*
- *Distance to Uptown vs. frequency of visits, by top mode*
- *Primary reason to visit Uptown vs. frequency of visits.*

4.1.2.1 Compared to travel mode

Among the respondents, there was a strong tendency for users of active transportation to visit Uptown more frequently, as seen in Figure 9. Survey participants visited Uptown a median of 16 times over 30 days, with a majority making between 7 and 23 trips. Over 10% of respondents visited more than once per day. The distributions of visiting frequency are non-normally distributed both overall and for every transportation method except bicycling (Shapiro-Wilk $p \approx 0$ and $p=0.42$ respectively), with moderate skew towards higher frequencies of monthly visits, so medians and interquartile ranges are used for comparative purposes.

With respect to total frequency of trips – including those that respondents made using modes of transportation other than their preferred one – pedestrians visited Uptown most frequently, with a median of 21 visits over the month and a majority visiting between 12 and 34.5 times. Considering the proximity of most pedestrians to Uptown, this is evocative of the goals of local, neighbourhood-situated commercial space: to provide a highly accessible space that nearby residents can visit frequently, for a variety of purposes. Bicyclists visited almost as frequently, with a median of 19 trips and an interquartile range of 12-23.

Those using vehicles came with less frequency. Public transit users visited between 5 and 16 times per month overall, with a median of 13. Those with personal vehicles only visited a median of 7 times per month, with a majority from 5-17. Given the City's concerns regarding traffic congestion and the need to find parking (Region of Waterloo, 2003), this reduced visitation rate is unsurprising.

There is very strong evidence (Kruskal-Wallis $p=0.0001$) that mode choice is a significant predictor of total trip frequency. The differences in frequency of visits by public transit and by personal vehicle are not noteworthy (Kruskal-Wallis $p=0.55$), and neither are those between

bicyclists and pedestrians (p=0.164). However, public transit users visited significantly less frequently than bicyclists (p=0.0035) and pedestrians (p=0.0024), as did drivers (p=0.0001 with respect to both). Notwithstanding the infrequent use of public transit, this is consistent with a general trend for users of active transport methods to make more frequent shopping trips (Baker & Macdonald, 2006; Clifton et al., 2013; Popovich & Handy, 2014), and also supports the City's goal of making Uptown's streetscape appealing to sustainable, active transportation methods (Uptown Waterloo, 2012).

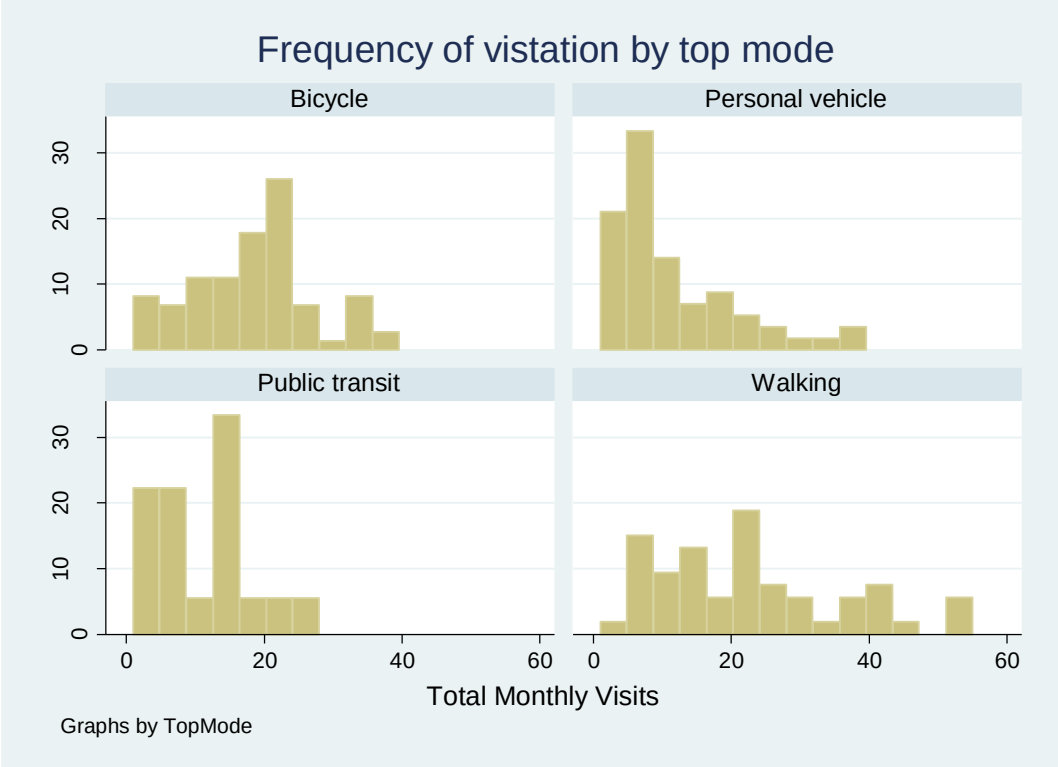

Figure 9: Frequency of visits by top means of reaching Uptown (Web survey, nBicycle=73, nVehicle=53, nTransit=19, nWalk=56)

The correlation between active transportation methods and increased visitation rates holds when only trips by the preferred mode of transportation are taken into account, as shown in

Figure 10. Bicyclists and pedestrians both averaged 15 trips per month using their respective preferred methods of transportation alone, with pedestrians showing greater variability overall at an interquartile range (IQR) of 8-20 compared to the bicyclists' 10-18. Those who favour public transit bus to Uptown a median 7 times per month, while drivers, being more homogeneous overall in their transportation choices, fell only slightly to a median of 5. There is again very strong evidence (Kruskal-Wallis p=0.0001) that mode choice significantly impacts trip frequency overall, when contrasting drivers to bicyclists and pedestrians (p=0.0001 for both), and when contrasting public transit users to bicyclists (p=0.0047) and pedestrians (p=0.0015).

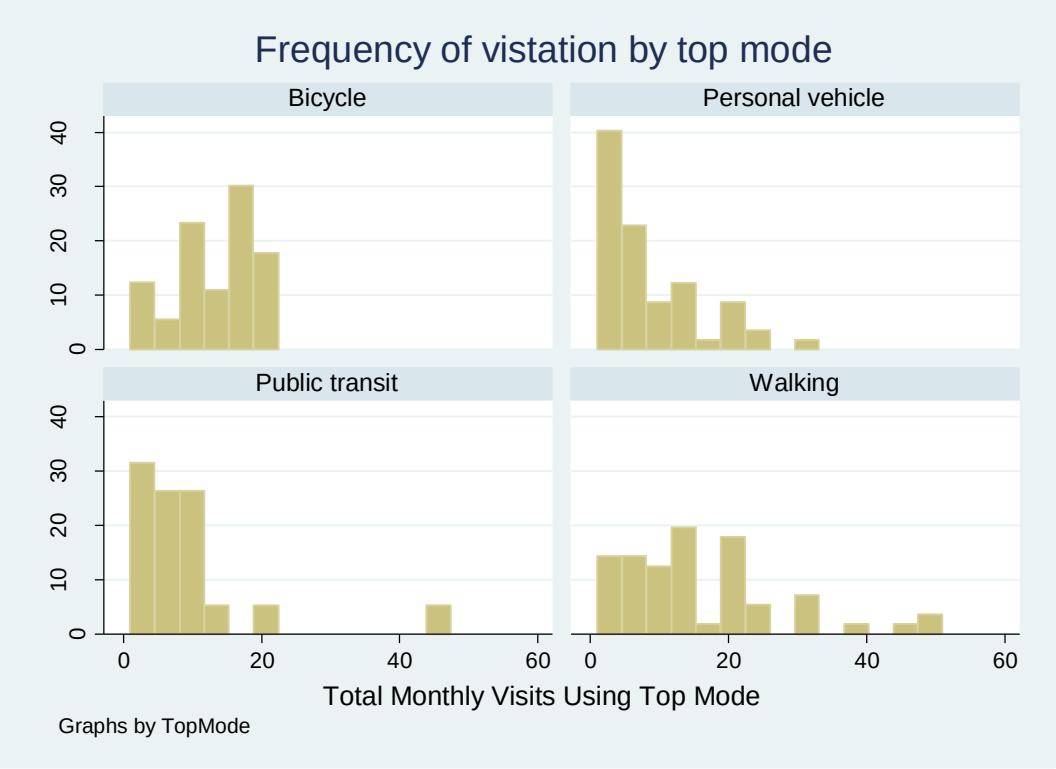

Figure 10: Frequency of visits by top means of reaching Uptown (Web survey, nBicycle=73, nVehicle=57, nTransit=19, nWalk=56)

4.1.2.2 Compared to travel distance

There is, overall, a statistically significant but weak correlation between the total number of monthly trips made and the distance traveled. There is very strong evidence ($p=0.0003$) supporting the model:

Equation 1: Total Monthly Trips = 21.5 – 1.2(Distance in km)

The predictive capacity of this model is minimal, with an $r^2=0.0565$. Taking into account that the strength of the disincentive travel distance poses likely plateaus at a certain range, an alternative potential model makes use of the natural logarithm of the distance: ln(Distance in metres). There is also very strong evidence in support of the revised model ($p\approx0$):

Equation 2: Total Monthly Trips = 73.5 – 7.3ln(Distance in metres)

At an r^2 of 0.1894, the relationship remains weak, but is not negligible.

It has already been observed that there is a strong relationship between frequency of visits and preferred travel mode. Taking this into account, a more accurate model may be provided by looking for correlations within each travel mode.

Doing so confirms that the modes of transportation most closely associated with greater mobility, the personal vehicle and the bicycle, are least affected by the distance traveled. Neither the distance nor the ln(Distance) generated any meaningful results for the personal vehicle: the models had negligible predictive capacity and errors of $p=0.81$ and $p=0.79$ respectively. Bicyclists, meanwhile, did show very strong evidence of responding to both measures of distance:

Equation 3: Total Visits = 22.1 – 1.2(Distance in km) and

Equation 4: Total Visits = 42.0 – 3ln(Distance in m)

Although the evidence supported a correlation for both raw distance ($p=0.022$) and its natural logarithm ($p=0.037$), the models had minimal predictive capacity at $r^2=0.072$ and $r^2=0.060$ respectively. Clearly, while the choice to bicycle to Uptown is partially informed by distance, other factors play a much larger role in determining the decision.

This is to be expected. For Waterloo bicyclists, road safety, road conditions, and bicycle paths (and lanes) all play large roles in the decision making process – in short, the question becomes not how many metres are traveled, but how enjoyable or stressful those particular routes are (Casello & Rewa, 2011; Heesch et al., 2014), unless the traveler has no option but to bicycle.

For people who favoured public transit and walking, the rate of visiting Uptown was demonstrably informed by the distance. For public transit users, there was strong evidence in support of a relationship with distance ($p=0.0284$) and very strong evidence in support of one with the natural logarithm ($p=0.0008$). By these measurements:

Equation 5: Total Visits = 29.81 – 6.2(Distance in km) or

Equation 6: Total Visits = 185.5 – 22.1ln(Distance in m)

Both of these models have appreciable predictive capacity, with $r^2=0.21$ for the former model and a respectable $r^2=0.47$ for the latter (See Figure 11). A visual examination of this graph, however, suggests that it is disproportionately influenced by an outlier at each end of the distribution, as well as by the low overall sample size of those who most often traveled to Uptown by public transit.

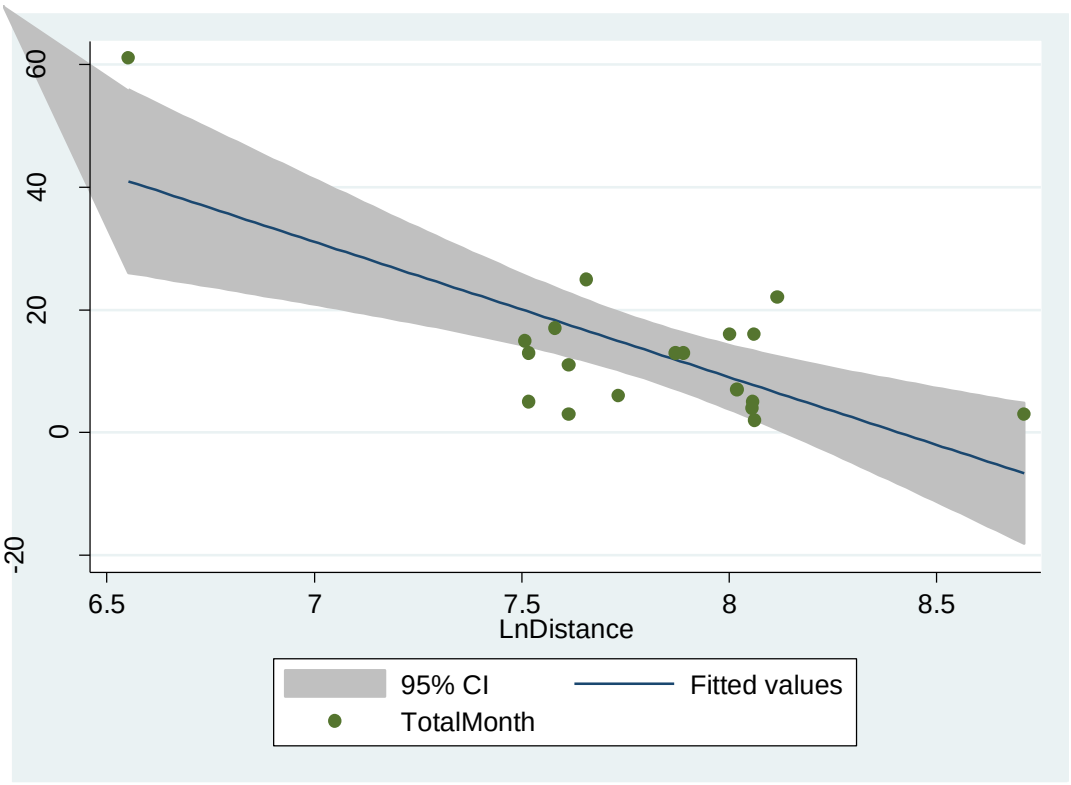

Figure 11: Total monthly visits vs. ln(Distance) of primary public transit users (web survey, n=18)

The models for pedestrians, however, are not undercut by low sub-sample sizes, with 56 observations compared to the 19 of the public transit users. There is little evidence supporting a correlation with raw distance ($p=0.125$), but very strong evidence in support of a correlation with the natural logarithm of the distance ($p=0.0008$). So:

Equation 7: Total Visits = 102.5 – 11.25ln(Distance in m).

With a predictive capacity of $r^2=0.173$, the direct relationship is weak but present. At first glance (see Figure 12), this appears obvious: as seen with the distribution of pedestrians, people who are close by are more inclined to walk. However, this highlights the fact that pedestrians are primarily coming from the transitional neighbourhoods around the edges of

Uptown's commercial core. Following the model, the most dedicated pedestrian consumers in such a development are those who elect to live at the fringes of that development. Uptown Waterloo enjoys a variety of different residential environments nearby, from low-rises to single detached houses; when designing other similar spaces, the housing options peripheral to the commercial core will inform who becomes the space's most reliable customers.

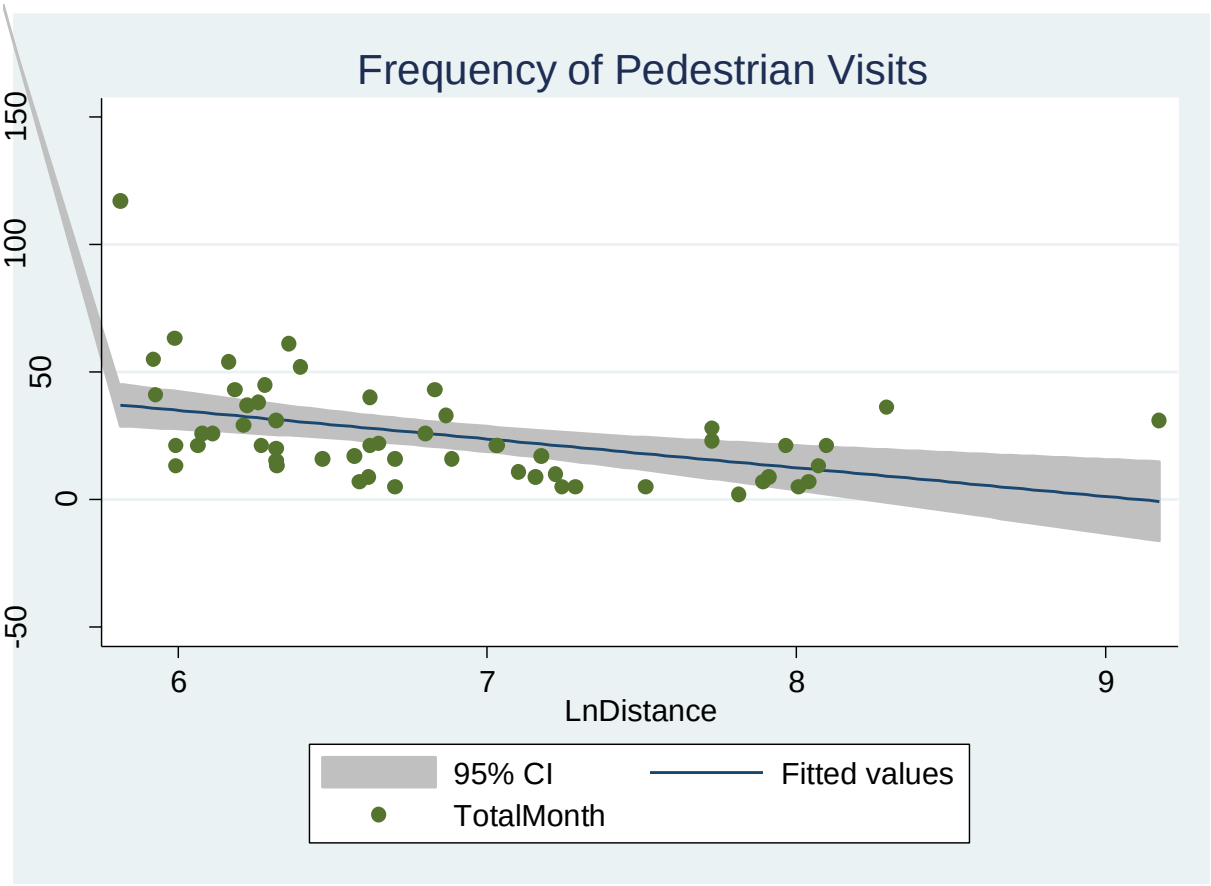

Figure 12: Total monthly visits vs. ln(Distance) for people who visit most on foot (web survey, n=56)

4.1.2.3 Reasons for Visiting

Of the different primary reasons for visiting Uptown, the most frequent visits (discounting the three who live in Uptown proper and one who only visits to board the bus) were from people who go there to work; with a median 22 visits per month. Those whose main reason to go to Uptown is shopping come almost as frequently, with a monthly median of 18 visits. There is strong evidence (Kruskal-Wallis p=0.042) that this gap is significant. There is also moderate evidence that those who come to shop do so more frequently than those who primarily come for recreation (p=0.069) or studying (p=0.580), and strong evidence that shoppers come more frequently than diners (p=0.01). Figure 13 illustrates these gaps.

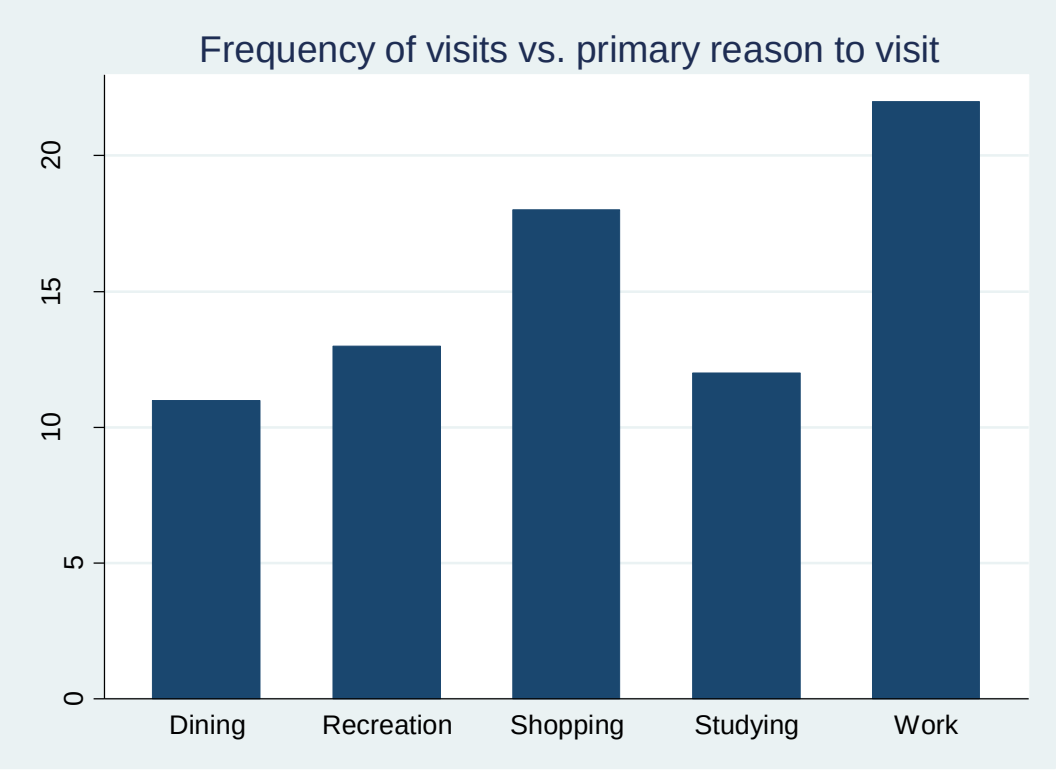

Figure 13: Stated primary reason for traveling to Uptown (web survey, nDining=50, nRecreation=48, nShopping=74, nStudying=3, nWork=27)

There is, however, no evidence (Kruskal-Wallis p=0.1343) that people arriving for different reasons spend in different amounts. The similarity of expenses from recreational visits to those from work- or shopping-related trips could suggest a general baseline of hedonic activity that is demonstrated to add a recreational component even to purposeful trips (Arnold & Reynolds, 2003).

4.1.3 Do people shop differently using different modes?

- *Amount spent by travel mode*
- *Number of destinations (on last trip and over one month) by mode and distance*
- *Choice of destinations, by mode*
- *Expenses vs. frequency of trips, by mode*
- *Rates of trip-chaining and trip chain length, by mode and by gender*

4.1.3.1 Total Expenses

Both the in-person and web surveys inquired after the amount spent in Uptown. Participants in the in-person survey provided an estimate of the total amount they expected to spend on their current trip to Uptown, while the web survey asked how much was spent at each of the different business types the participants visited on their most recent trip.

In the in-person survey, all spending patterns followed non-normal distributions (Shapiro-Wilk p≈0), so non-parametric methods of evaluation are used. Across all transportation modes, most purchases ranged from $1-50, with outliers reaching as high as $400 (See Figure 14). Median total expenses, however, were $15 for bicyclists and public transit users and $20 for drivers and pedestrians. Given the extent to which these expense distributions overlap, there is little evidence (Kruskal-Wallis p=0.168) that total expenses differ markedly across transportation modes.

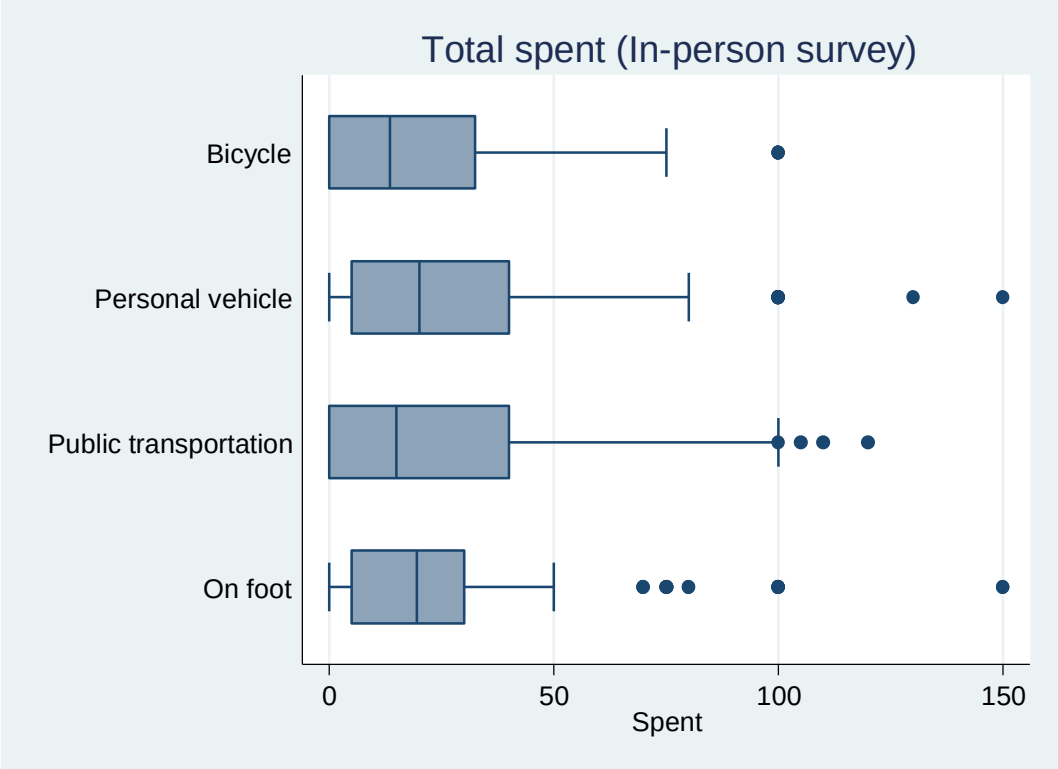

Figure 14: Quartile diagram of total expenses at Uptown (In-person survey: nBicycle=100, nVehicle=106, nTransit=102, nFoot=108)

(This figure does not display totals above $150: three drivers, one bicyclist, and one pedestrian.)

The online survey does not provide a precise comparison for this figure, since participants were asked the amount they spent at varying businesses on their most recent trip to Uptown but not which method of transportation they took on that specific trip. For the purposes of drawing a rough comparison, it is assumed that everybody took the mode of transportation they most frequently use on their most recent trip to Uptown.

Responses in the web survey were similar (see Figure 15), except for the fact that drivers spent 40% less on average. Bicyclists' and public transit users' median expenses remained $15, while pedestrians' fell slightly to $17 and drivers' dropped to $12. Again, there is no evidence

(Kruskal-Wallis p=0.52) that the different transportation methods have different distributions of total expenses overall.

Neither group of participants was asked to track their purchases over any period of time, so this accounting of expenses is based on estimation and inference on the respondents' part at best. However, the consistency with which the different transportation modes reported similar expense patterns supports the assumption that travel mode is not a meaningful indicator of willingness to spend. When the increased frequency with which users of active transportation methods are observed to visit Uptown, their total monthly spending could markedly exceed that of drivers.

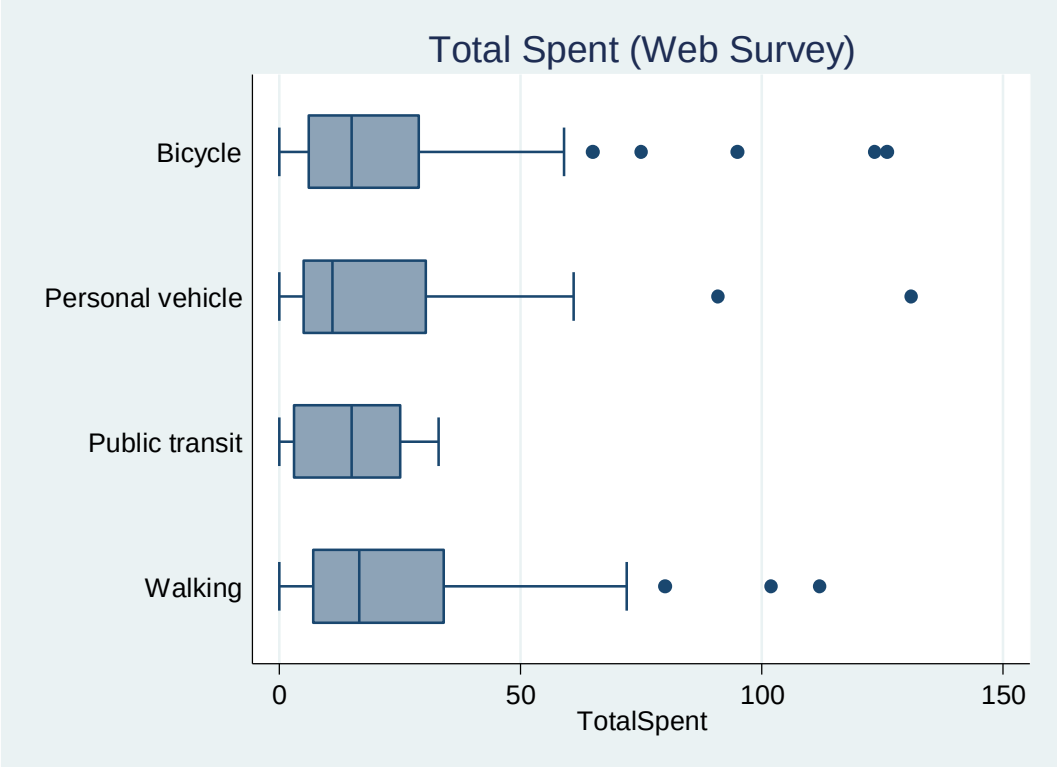

Figure 15: Quartile diagram of total expenses on last trip to Uptown (Web survey, nBicycle=73, nVehicle=57, nTransit=19, nWalk=56)

4.1.3.2 Variety of Destinations

Of the different business types described, the most popular destination in the in-person survey for every transportation mode but bicycling was grocery shopping. Figures 16 and 17 show all different destination types. The disproportionately high incidence of alcohol shopping among bicyclists is possibly attributed to the number of bike racks within a half-block of the Uptown LCBO, but could also represent a real shopping tendency by cyclists.

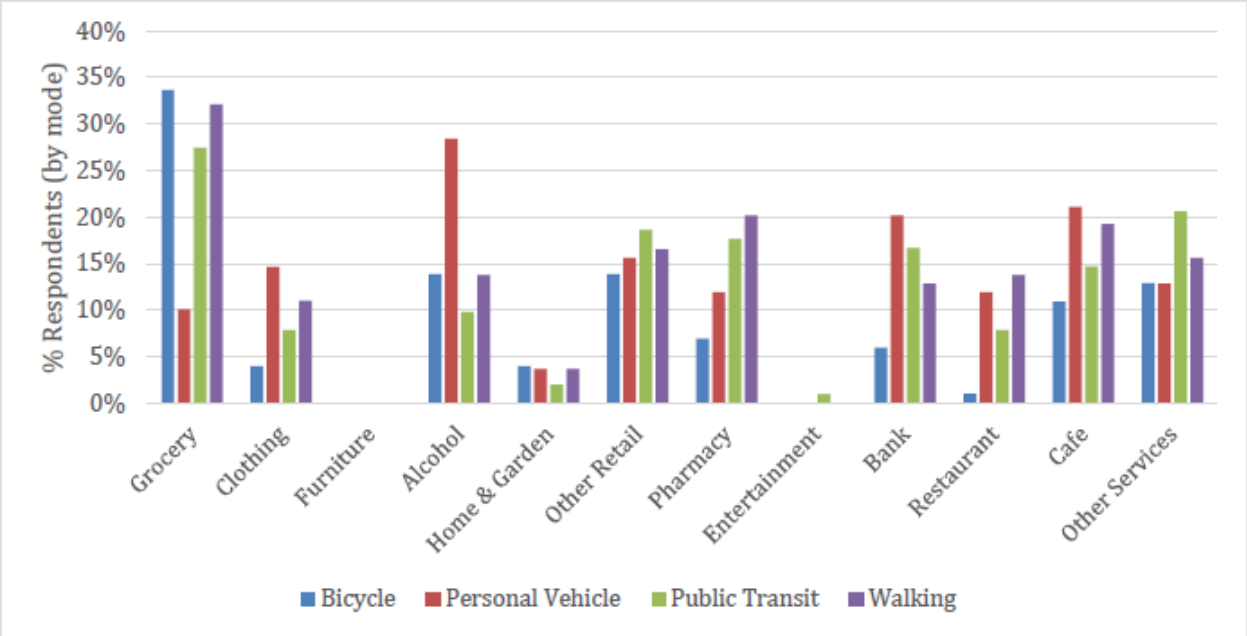

Figure 16: Popularity of destination(s) during current trip to Uptown (In-person survey: nBicycle=101, nVehicle=109, nTransit=102, nFoot=109)

Previously printed in Moos, Casello, Chase, & Lanoue (2015)

In the web survey, participants reported spending money at more businesses overall than they did in the in-person one. In addition, a marked preference towards restaurants and cafés emerged. Taking into account the times of day the in-person survey was administered, this could be a more accurate assessment of the economic importance of the food services in Uptown.

Among web survey responses, restaurants and cafés were used consistently by all transportation modes, perhaps picking up on early-morning coffee runs and the dinner hour, both of which would have occurred when data collection at Uptown was not taking place. These additional destination points suggest Uptown's value as a recreational site: one with a variety of specialty retailers and food services to be enjoyed at relative leisure.

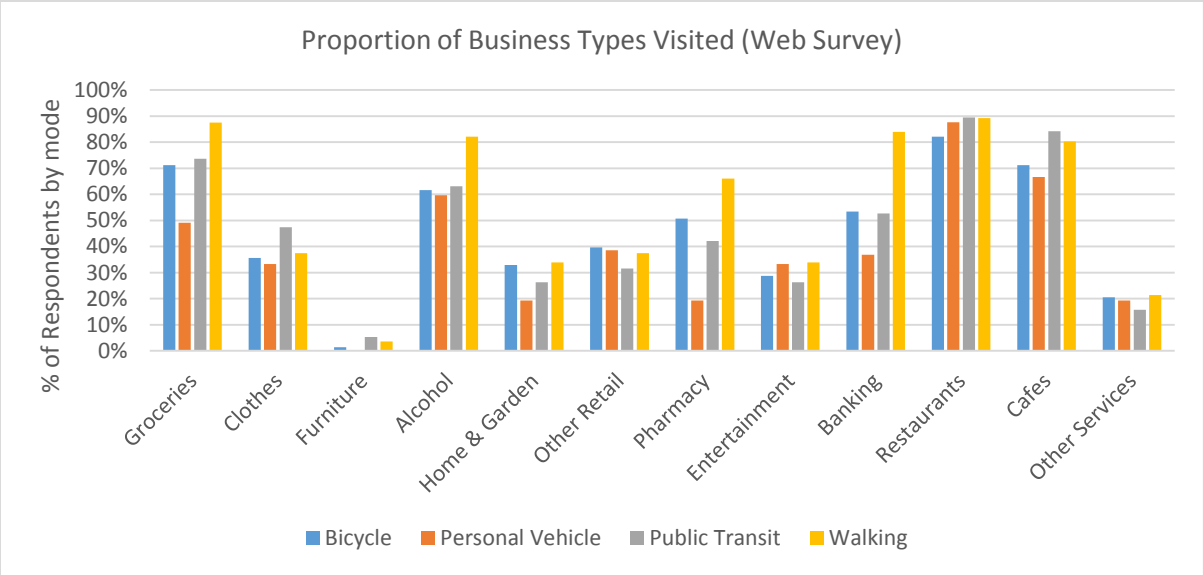

Figure 17: Popularity of business types over one-month period (web survey, n=206)

Previously printed in Moos, Casello, Chase, & Lanoue (2015)

From web survey participants' accounts of their last Uptown trip, the choice of destination was almost entirely consistent across travel modes: looking at which businesses people spent money at found no significant variations by mode (χ^2 $p>0.1$) were found for any business type but groceries (χ^2 $p\approx0$). There, pedestrians were much more likely to have spent money grocery shopping (64.2%) than bicyclists or public transit users (45.2%, 47.3%), while drivers were by far the least likely to have done so (24.5%). That the most frequent visitors are also most likely to come for purchases like groceries is curious: even such utilitarian errands have a hedonic value to them (Yim et al., 2013), and providing an enjoyable setting for them

explains why people would be inclined to visit often (M. A. Jones et al., 2006) rather than wait on a more purposeful errand run.

Participants in the web survey were also asked to describe which of the above business types they had visited in the previous month. To provide a general indicator of the variety of trips they made, the different destination points were summed. The resulting variable was normally distributed both overall (Shapiro-Wilk $p=0.76$) and for each most-used transportation mode, so parametric statistics are appropriate. Almost all respondents visited Uptown for multiple reasons in the course of the month; 5.6 destinations were visited on average, with a majority falling between four and seven per month. Analysis of variance provides very strong evidence ($p=0.0003$) of an association between preferred travel mode and the variety of destinations enjoyed. People arriving by personal vehicle visited a lower average of 4.6 places, while pedestrians exhibited the most varied behaviour at 6.6; public transit users and bicyclists fell almost exactly on the mean. Pairwise comparison of means finds the differences between pedestrians, bicyclists, and drivers significant at $\alpha=0.05$, though public transit users' behaviours were too variable to establish significance While these distinctions are not extreme, it is consistent with the trend for pedestrians to avail themselves most of local convenience shopping and food services (Clifton et al., 2013).

By this indicator, those living closer to Uptown tend to enjoy a broader range of its services. A regression model of the number of destinations visited versus the natural logarithm of the travel distance (in metres) shows strong evidence ($p\approx0$) that people living farther away visit fewer different business types, though the model has only moderate predictive capacity ($r^2=0.21$). This relationship is significant (at $\alpha=0.05$) for all transit modes except drivers

(p=0.19), but is especially marked for public transit users (p=0.017, r^2=0.30), whose service variety declines most steeply with distance.

4.1.3.3 Trip Frequency & Expenses

Without a more in-depth accounting of monthly travel and spending patterns, it is difficult to gauge how frequency of visits is linked to expenses. As it is, the closest the topic can be approached is by comparing web survey participants' total expenses on their last shopping trip to the frequency with which they visited Uptown in the past month. Interestingly, comparing the two in a scatter plot suggests that active transportation users do tend to spend more per visit if they visit more. This could be indicative of a greater familiarity with the businesses in Uptown and thus greater willingness to pay, or simply that people who spend more time there generally end up spending more money.

Investigating this tendency (as depicted in Figure 18) with a linear model yields little further information. Attempting to model total expenses from frequency of visits has neither statistical significance nor any predictive value for personal vehicle users and public transit users. However, for pedestrians and bicyclists, it has moderate (p=0.10) and strong (p=0.05) significance respectively, albeit at a very low level of predictive power (r^2=0.03 and r^2=0.04 respectively).

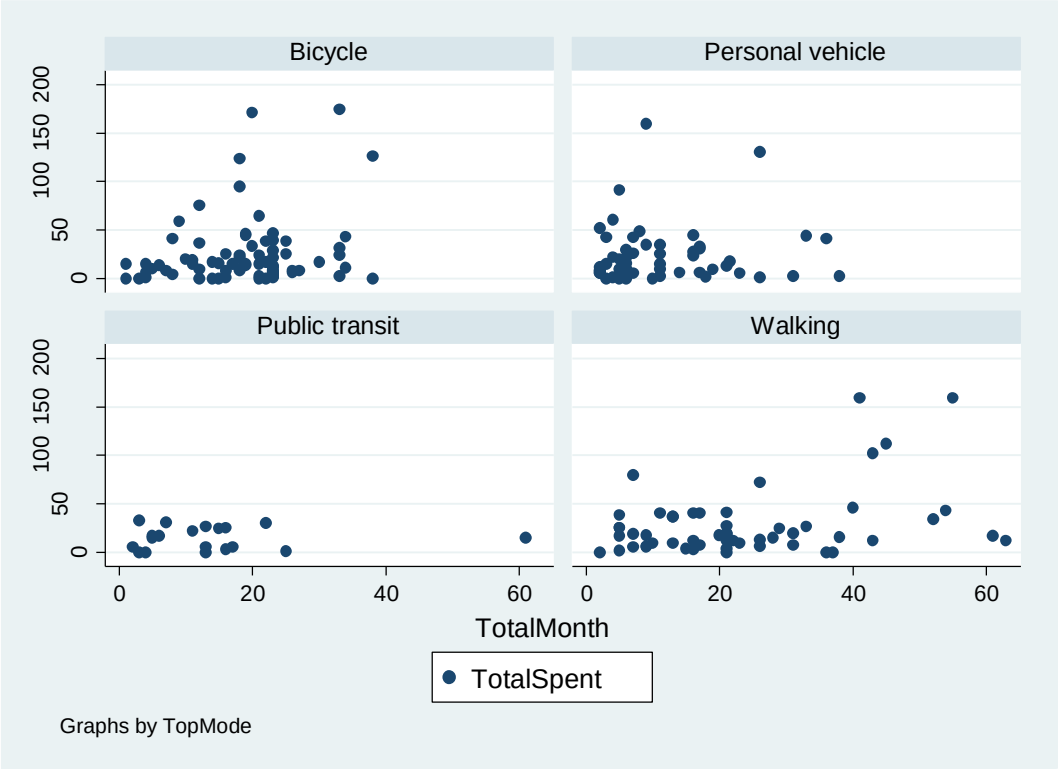

Figure 18: Total expenses on last Uptown trip vs. total monthly visits to Uptown, by most-used means of reaching Uptown (Web survey, $n_{Bicycle}=73$, $n_{Vehicle}=53$, $n_{Transit}=19$, $n_{Walk}=56$)

4.1.3.4 Trip Chaining

Trip chaining, the practice of visiting more than one destination on a single outing, was highly popular among web survey respondents. This was measured by the number of businesses the participants reported spending money at during their last trip to Uptown. Note that this means of evaluation underestimates the number of locations visited, since it does not take into account places that the participant visited but at which no money was spent. Since the web survey assumes a purposeful trip to Uptown, not merely passing through, a trip chain of zero can be assumed to indicate a wholly recreational trip, window shopping, or a trip that only visited sites (like the bank) where money was not spent.

Even taking into account the 9.2% of people who did not spend money at any businesses, a strong trend towards trip chaining emerged in participants: only 26% of visits were to one business only, while 28% of participants spent money at four or more businesses. Among shopping trips where money was spent, the median number of destinations is 3. Unsurprisingly, trip chaining is strongly associated with increased total expenses ($r^2=0.334$, $p\approx0$).

This rate of trip chaining is well beyond the average seen in shopping studies. As of 2005, a study of morning and evening driving commutes found that 54.5% of men and 60.6% of women trip-chained (Baldwin & Fagan, 2007). By comparison, looking only at non-zero trip chains, 65.2% of men and 76.6% of women who spent money at Uptown did so at more than one location, a gap from the national trend that reaches statistically significant levels for women (at $\alpha=0.05$). In addition, survey participants strongly favoured longer chains. Male and female participants spent at only two destinations in half the national numbers (~19.5% vs. $40%), while chains of 3 or more far more likely to occur. 44.6% of male Uptown shoppers and a 57.4% majority of female ones visited three or more destinations, compared to 14.6% and 20.5% of the general population respectively (Baldwin & Fagan, 2007).

Statistics Canada considered men and women separately for purposes of investigating trip chaining. Among survey participants, there is little evidence (Kruskal-Wallis $p=0.188$) to suggest that this is a necessary distinction. Although female participants' shopping trips involved spending at a median of three destinations compared to males' two, women skewed towards longer chains than men did, with a quarter of trips involving four or more spending points. It is possible that this is underestimated due to the survey only asking after *types* of businesses spent at rather than the total number of businesses: if, for example, a shopper were to visit more than one specialty store, this would not be represented by the responses.

There is moderate evidence (Kruskal-Wallis p=0.0611) of a relationship between trip chaining and the distance traveled; however, the nature of this relationship is obscured by different travel modes' tendencies towards different levels of trip chaining and different median distances. Expressed as a linear model, there is a statistically significant (p=0.0033) but negligibly weak (r^2=0.037) tendency for longer trips (expressed in ln(Distance)) to have shorter trip chains, a result that runs counter to the assumption that longer trips would be made more involved. When this model is broken down into the different top transportation methods, the only model with any statistical significance (p=0.01) and predictive capacity (r^2=0.10) is for pedestrians:

Equation 8: Trip Chain length = 9.61 – 0.94ln(Distance in m)

Although pedestrians have a higher median trip chain than other transportation modes (i.e. 3 vs. 2 for the others), rates of trip chaining by most-used transportation mode have a high degree of overlap and there is little evidence (Kruskal-Wallis p=0.15) that this discrepancy is statistically significant. This speaks well to Uptown's objectives as an accessible commercial core: it obviates the need to bring a vehicle to the day's errands or recreation, providing instead a shopping environment that can be navigated as easily on foot or by bicycle. The high rate of trip chaining can be attributed to the clustered commercial landscape (Brooks, Kaufmann, & Lichtenstein, 2008), and encourages hedonic shopping through the streetscape (Spokane et al., 2007) and selection of diversions (Arnold & Reynolds, 2003; Yim et al., 2013).

4.2 Is sustainable transportation use linked to socioeconomic status?

4.2.1 Transportation and Demographics

- *Overall primary transportation mode*
- *Age distributions, by primary mode*
- *Income distributions, by primary mode*
- *Gender vs. primary mode*

Survey participants were asked to provide their primary mode of transportation (Figure 19). Although a 35.4% plurality primarily used personal vehicles, the other modes garnered a great degree of representation. 29.1% of respondents are primary bicyclists, 14.1% use public transit, and 18.9% walk. The remaining 2.5% who gave "Other" responses indicated in comments either that they had no single preferred transportation method or that their preferred method varied seasonally.

The choice of primary transportation mode is linked to participant age. As age distributions are not normally distributed for any mode category (Shapiro-Wilk $p<0.01$ for all), they are compared by median age (and interquartile range). Users of public transit are the youngest overall at a median age of 27 (IQR 24-36), perhaps due in part to the UPass system available to nearby university students. Bicyclists are only slightly older, with a median age of 30 (IQR 26-40). Drivers and walkers both had a median age of 36; however, personal vehicles were favoured by older participants with an IQR of 31-49 compared to 30-43 for pedestrians. There is very strong evidence that these age differences are not due to chance (Kruskal-Wallis $p= 0.0001$).

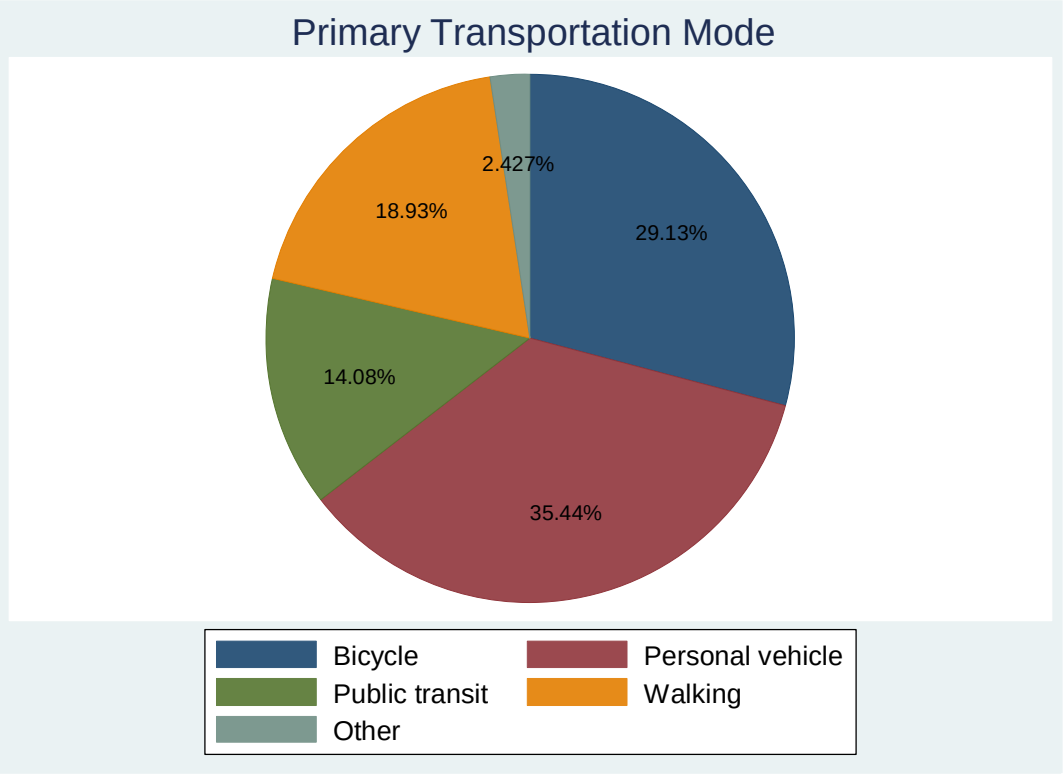

Figure 19: Self-reported primary mode of transportation (Web survey, n=206)

Comparing the gaps individually, there is moderate evidence that bicyclists are older than public transit users overall (Kruskal-Wallis p=0.090), very strong evidence that drivers and pedestrians are older than bicyclists (Kruskal-Wallis p=0.0008), and little to no evidence that drivers and pedestrians are of different age groups overall (Kruskal-Wallis p=0.484).

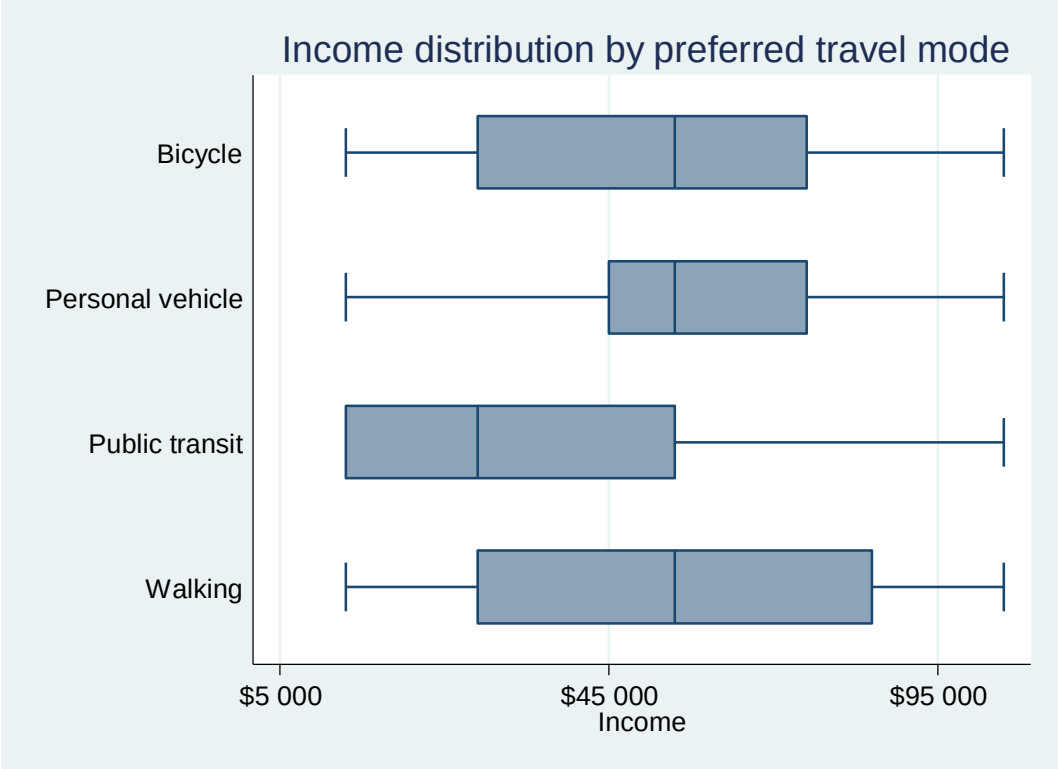

Figure 20: Box plot of incomes by primary travel mode (Web survey, nBicycle=56, nVehicle=60, nTransit=27, nWalk=34. Non-responses: 4, 13, 2, and 5 respectively.)

Choice of transportation mode also varies according to income level, as shown in Figure 20. As some modes' income distributions are likely (Shapiro-Wilk p=0.032) non-normal, non-parametric tests are used for purposes of comparison. Public transit users have the lowest median, followed by bicyclists and drivers, with pedestrians the most affluent overall. There is strong evidence that these distinctions are statistically significant (Kruskal-Wallis p=0.042), although the only significant individual gaps are those between public transit users and drivers (Kruskal-Wallis p=0.013) and between public transit users and pedestrians (Kruskal-Wallis p=0.019).

That public transit users tend towards the lower income brackets while drivers tend to be more affluent is perhaps unsurprising given the financial requirements of vehicle ownership and maintenance (Stokes & Lucas, 2011). The high median income of pedestrians is intriguing. Given that participants living within easy walking distance of Uptown are not markedly more affluent than those living farther away, this tendency for higher-income people to walk could be indicative of increased capacity to walk for pleasure and convenience, or of a living environment that is accessible to pedestrian shoppers (Baker & Macdonald, 2006). In addition, both forms of active transport are used by a broader range of incomes than personal vehicles are. This supports the assumption that the choice to use active transport can be informed by personal preferences for leisure, health, and environmental consciousness, as well as by financial restrictions.

There is inconclusive evidence of a correlation between participants' gender and their primary mode of transportation (χ^2 $p=0.10$). As is often the case (Casello & Rewa, 2011), male participants are most likely to travel by bicycle, with a 38.1% plurality of male respondents listing it as their preferred transportation method compared to 22.3% of females. A 39.8% plurality of women travel primarily by personal vehicle, compared to 33.0% of men; women walk more than men by a similar margin. Use of public transit was not differentiated by gender.

The distribution of primary transportation modes is drastically different among survey participants than in the general population. One means of comparison is the census' data series on the travel mode used for commuting; note that a direct comparison of the two assumes that respondents' mode of traveling to work is identical to their primary mode of transportation. 88.2% of Kitchener workers took personal vehicles to work as drivers or passengers compared to only 35.4% of survey respondents, whereas the survey's 14.1% of public transit users far outnumbers the CMA's 5.4%. Compared to the 4.3% and 1.1% of Kitchener residents who

walk and bicycle, respectively, the participants' 18.9% and 29.1% are an impressive commitment to active transportation.

Given this discrepancy, it is difficult to compare the travel habits of different age groups of survey participants to those of the Census Metropolitan Area overall; too few responses from those aged 55+ were obtained to permit further sub-categorization. Among the younger groups, use of bicycling as a primary travel mode peaked in the 15-24 and 25-34 groups, at 38.1 and 37.2% of respondents respectively, but fell to 18.0% for the 35-44 group. Use of personal vehicles rose in proportion to age: 4.8% of the 18-24 age group primarily drove, compared to 56.3% of the 45-54 group. Walking was the most consistently used primary mode of transportation with respect to age, with a low of 9.5% use in the 18-24 group and a high of 26.0% in the 35-44. Public transit peaked sharply at 42.9% use in the 18-24 group, a threefold increase over any other age group.

The different preferences of primary transportation mode by gender also reflect trends in the broader Census Metropolitan Area population. Among Kitchener residents, men were more than twice as likely as women to use a bicycle for the commute (2.3% vs. 0.9%). The gap is far less dramatic among the survey participants (38.1% vs. 22.3% respectively). Female survey respondents' preferential use of personal vehicles to commute is echoed in the Census Metropolitan Area, although to a far lesser extent (89%, vs. 86% among men). Although women make up 60.1% of public transit users in the CMA, use of public transit as a primary mode was approximately equal among survey participants.

Overall, different demographics' preferences for different transportation methods were observed among survey respondents, but are outweighed in significance by the participants' increased use of sustainable transportation modes like bicycling, walking, and public transit.

Foot traffic is a popular option across age groups and income levels, even among residents living well away from the "10-minute walk" perimeter. That the preferential use of bicycles by younger people and men in the Census Metropolitan Area is mitigated among the survey participants is interesting.

4.2.2 Transportation and Neighbourhood Affluence

- *Home census tract median income, by primary mode*
- *Home census tract low-income prevalence, by primary mode*

As discussed previously, the choice of transit mode is stratified by age and by income level. For the purpose of generalizing these trends, it is helpful to examine whether these demographic characteristics are typical of the respondents' neighbourhoods, and whether neighbourhoods displaying those demographic trends consistently favour particular travel modes among the respondents.

In addition to the relationship between respondents' personal incomes and their choice of travel mode, there is a strong link between respondents' travel modes and the income distributions of their neighbourhoods. A simple measure of this is the census tract's median income. There is strong evidence (Kruskal-Wallis $p=0.0107$) of a relationship between respondents' mode choice and census tract median income; as with personal income, public transit use is associated with lower income (median $29 333), active transport falls in a middle ground (medians $30 930 for walking, $31 146 for bicycling), and personal vehicles are used most by respondents in higher-income census tracts (median $33 042). By comparison, the CMA median income is $32 633. Most of these pairwise differences are not significant at $\alpha=0.05$, but respondents who most frequently drive to Uptown stand out as having the highest

neighbourhood median incomes, significantly surpassing bicyclists (Kruskal-Wallis p=0.0174), pedestrians (p=0.0141), and public transit users (p=0.0057).

By a different measure of neighbourhood wealth, this trend becomes more pronounced. The prevalence of low-income residents in respondents' census tracts is non-normally distributed (Shapiro-Wilk p=0.001) and significantly associated with respondents' most-used means of reaching Uptown (Kruskal-Wallis p=0.0001). As with overall income, drivers' census tracts are the most affluent, with a median 9.7% prevalence of low-income status; bicyclists (14.6%) and pedestrians (18.0%) have intermediate levels; and public transit users' census tracts had the highest median low-income prevalence, at 21.0%. Again, only drivers' census tracts were more affluent overall than the CMA median of 12.0% low-income residents; low-income prevalence is also significantly lower than other travel modes' census tracts (Kruskal-Wallis p<0.001 for all). There is moderate evidence that bicyclists' census tracts have lower low-income prevalence than pedestrians' (p=0.061) and public transit users' (p=0.050), but little evidence (p=0.120) of a gap between public transit users and pedestrians.

Given the marked relationship between choice of travel mode and travel distance to Uptown, the possibility that these trends are best explained by distance from the city's central neighbourhoods rather than by travel behaviour must be considered. There is, in fact, strong evidence that respondents' distances from Uptown are correlated with their census tracts' median incomes (p=0.0228) and low-income prevalence (p=0.0009); however, in both cases, their linear models have minimal predictive capacity (r^2=0.0204 and r^2=0.0492 respectively):

Equation 9: CT median income = 30587.88 + 0.3596(Distance in metres)

Equation 10: CT low-income proportion = $0.1661 - (0.49*10^{-6})$(Distance in metres)

To wit: Uptown shoppers who live farther away are marginally more likely to live in higher-

income areas, though their choice of travel mode is a more reliable predictor of their neighbourhoods' affluence. Likely, this is due to the attitudinal factors informing the choices of neighbourhood and travel mode (Bagley & Mokhtarian, 2002; Schwanen & Mokhtarian, 2005).

4.2.3 Variety of Modes Used

- *Income and age vs. variety of modes used*

A rough indicator of transport wealth is the number of transit modes a person uses. Although lower-income residents tend to have access to fewer methods of transportation (Stokes & Lucas, 2011), there was little to no evidence of this relationship among the survey participants (χ^2 p=0.35). The tendency of the elderly to have reduced transport wealth was also not observed (χ^2 p=0.72), although the low number of elderly respondents makes this unreliable.

4.3 Do Uptown's shoppers show high socio-economic advantage?

4.3.1 Demographic Profiles

- *Age distributions of participants vs. Census Metropolitan Area*
- *Income distributions of participants vs. Census Metropolitan Area*
- *Employment categories of participants vs. Census Metropolitan Area*

4.3.1.1 Age

The survey participants' average age was 35.9 years, though the non-normal distribution of ages (Shapiro-Wilk p=0.0001) makes the median age of 34 years a more appropriate indicator. Participants' ages were clustered tightly around the average, with a kurtosis of 3.55 and an interquartile range of 28-44. None of the participants were minors, though this absence is almost certainly an artifact of the data collection method; the markedly low numbers of senior citizens and total lack of participants aged over 70 could indicate the same cause, a lower rate of use by those age groups, or both. Due to the non-normal distribution and to facilitate comparisons to census findings, the participants' ages were aggregated into ten-year groups, plus an 18-24 group (due to the lack of minors) and a 70+ group.

The age distribution of the survey participants was markedly different to that of the Census Metropolitan Area, the respondent census tracts, and the Uptown census tract: it is distinguished by its lack of minors and senior citizens, its comparatively low median, and its disproportionately high rate of response in the 25-34 age range. The first point is an important consideration when comparing summary statistics. Although the median age of the participants is 34 compared to the Uptown census tract's 36.2 and Census Metropolitan Area's 37.6, 22.1% of the CMA's residents are under 18 years of age; the median age of its adult population is ~42. Given that those age groups have distinct financial and mobility constraints as consumers, and that none of

the participants are underage, for the purposes of comparison, statistics will draw only from adult populations unless noted otherwise.

A striking element of the age distribution is the high number of participants in the 25-34 age range. 40.8% of survey respondents fall in that age group, a marked and significant increase (at α=0.05) from the 18% of Census Metropolitan Area adults who do. This discrepancy is not attributable to the demographics of the respondent census tracts, whose 25-34 age group is almost identical in proportion to the CMA group. It is mirrored to a lesser extent by the Uptown census tract's population, 30% of whom fall in that category. Residents of the Uptown census tract also tend towards childlessness: the under-18 proportion of the total population is only 9.6% in that area, less than half of the Census Metropolitan Area's average.

It is possible that the respondents' ages are influenced by Twitter's user demographics; the composition of Twitter users in the Region of Waterloo is unknown. However, more general analysis of Twitter accounts suggests that such an occurrence would heavily favour minors and new adults (Longley, Adnan, & Lansley, 2015), particularly males, in contrast to the 25-34 group so strongly represented among the respondents.

These tendencies begin to illustrate a distinct social demographic of young, relatively affluent professionals who favour Uptown both as a destination point and as a living environment. The age distribution of survey participants (see Figure 21), in particular the high representation of 25- to 34-year-olds, was almost identical between Uptown and the more distant neighbourhoods with higher proportions of baby boomers and children. Despite the Uptown census tract having a median age six years lower than the CMA average, the median age of survey participants from Uptown was equal to that of the participants from elsewhere, with interquartile ranges of 28-40 and 28-44 respectively. Further investigation should consider that

group as a distinct consumer demographic. Age is not, however, a significant predictor of total expenses in Uptown businesses at α=0.05.

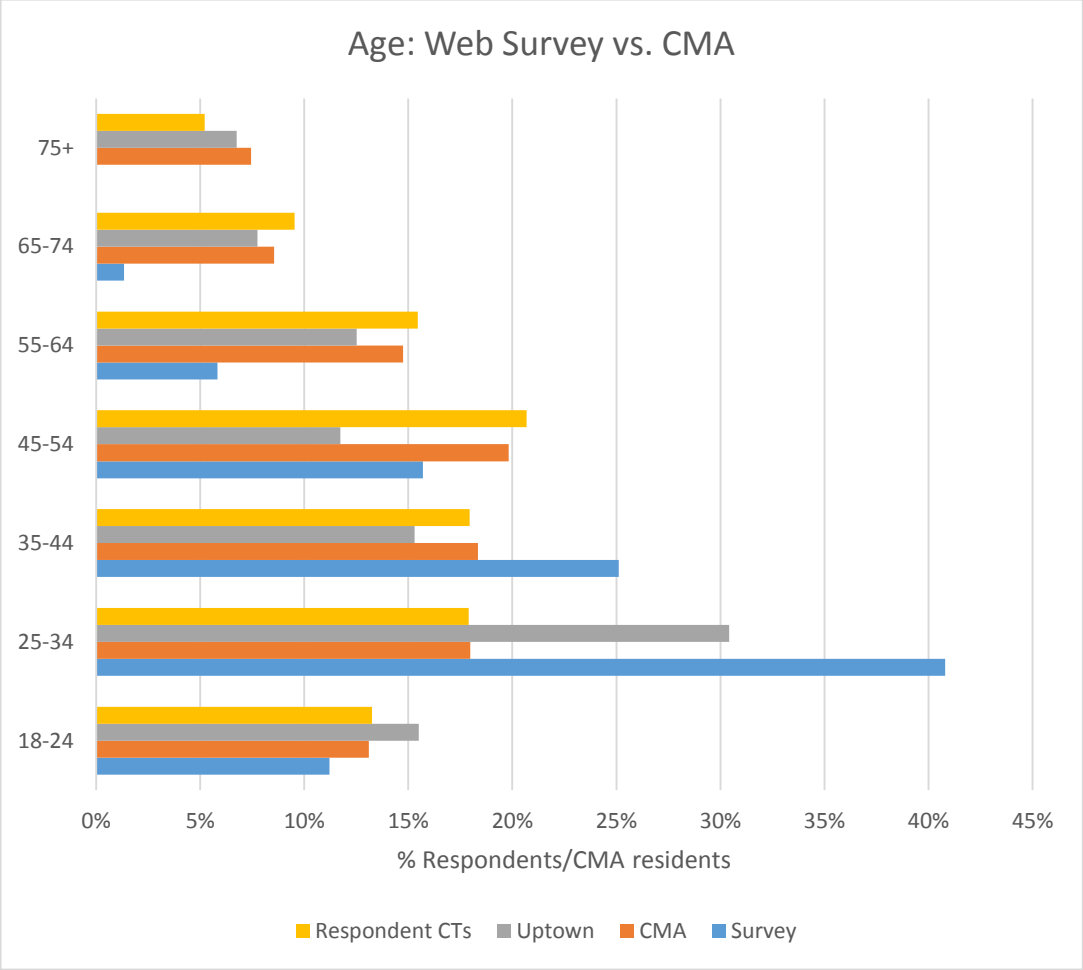

Figure 21: Age distributions of survey respondents, census tracts containing survey respondents, Uptown census tract, and Census Metropolitan area (Web survey and 2011 Census of Population, n= 206, 207 160, 2 515, and 371725 respectively.)

4.3.1.2 Income & Employment

Overall, the survey participants are comfortably employed (see Figure 22), with a median income in the $50 000-60 000 range. A majority of participants have incomes between $20 000 and $80 000. Of particular interest is the upper range of the distribution. 44% of participants'

incomes are $60 000 and above, including 8.7% whose incomes are over $100 000 annually. The single largest income bracket is $60-70 000, with fully 20.3% of responses. Lower income levels were less frequent: the $20 000 and under brackets accounted for 20% of participants.

These figures bear several caveats. This question grouped total personal income into $10 000 ranges to encourage responses, at the cost of rendering medians and ranges less reliable. Nonetheless, the question suffered an 11% non-response rate, the highest of the survey questions, although this was not concentrated in any age group or professional category.

Survey participants were found in all of the NHS occupational categories, although respondents were clustered in several distinct fields. "Education, law, social, community, and government services" was the most popular occupational group by a large margin, accounting for 28.8% of participants. "Business, finance, and administration" was second at 10.2% of respondents, with "Natural and applied sciences" close behind at 8.8%. However, participants were also given the option of choosing an "Other" category or grouping themselves as "Students" or "Retired", none of which correspond directly to categories on the NHS. The 11.7% of respondents who self-described as Students is perhaps inflated by the universities nearby, and could include those who are employed on-campus as well as full-time students with no income. The popularity of the "Other" option at 15.1% of respondents suggests that the category descriptions were misunderstood by some respondents.

Personal income was, of course, differentiated along employment industry lines. Discounting the 2.4% of retired respondents, the lowest-paid groups on average were employed in "Sales & Services" and "Management", both in the $20 000 – $30 000 range. Though such issues as length of job tenure and part-time versus full-time status were not raised by the survey, the sales industry's increased incidence of short-term and casual labour can be linked to this

lower income range. The most affluent respondents by a large margin were, confusingly, those in "Other" occupations with average earnings between $60 and 70 000, indicating either the ready availability of unconventional but lucrative income streams or that further clarification of the survey options is necessary. Of note is the distinction between the industry sector of the employer and the specific position held by the employee, which could be unclear to a survey participant.

Of interest is the large and well-paid "Education, law, social, community, and government services" sector. With an average salary of $50 000-60 000, they account in large part for the comfortable wage distribution of the participants as a whole, including among the 25-34 age bracket.

Students reported median wages in the $40 000 - $50 000 group. Their age distribution suggests the incongruity is due to graduate students or working professionals in continuing studies: of the 22 students who provided their incomes, nine were aged 25+, and seven of those had incomes over $40 000. Conversely, seven of the 13 aged 18-24 had incomes below $10 000.

The survey participants tended to be markedly more affluent than the Uptown area or the Census Metropolitan Area overall. The CMA workforce has a median annual income of $31 632, with the census tract containing the Uptown core slightly higher at $32 633. The median income of the survey participants is $50 000 - $60 000, and only 30% of participants reported incomes below $30 000.

Among the survey respondents, all income groups below $40 000 are much less represented than in the full Census Metropolitan Area. The difference between those respondents and CMA are significant at $\alpha=0.05$ for groups but the $10 000 - $20 000 group.

Conversely, the $60 000 - $80 000 and $80 000 - $100 000 income groups are greatly overrepresented in the responses, with double the proportion that those groups had among the general CMA: while those groups represent 20.3% and 14.8% of the survey respondents respectively, they account for only 10.2% and 5.9% of the general population, a gap that falls well outside the 95% confidence intervals for the survey distribution. The income distribution of residents in the Uptown census tract largely approximates that of the CMA, but with an altogether more even spread than the CMA; compared to the Census Metropolitan Area, mid-range incomes are less common and very low or high incomes more so.

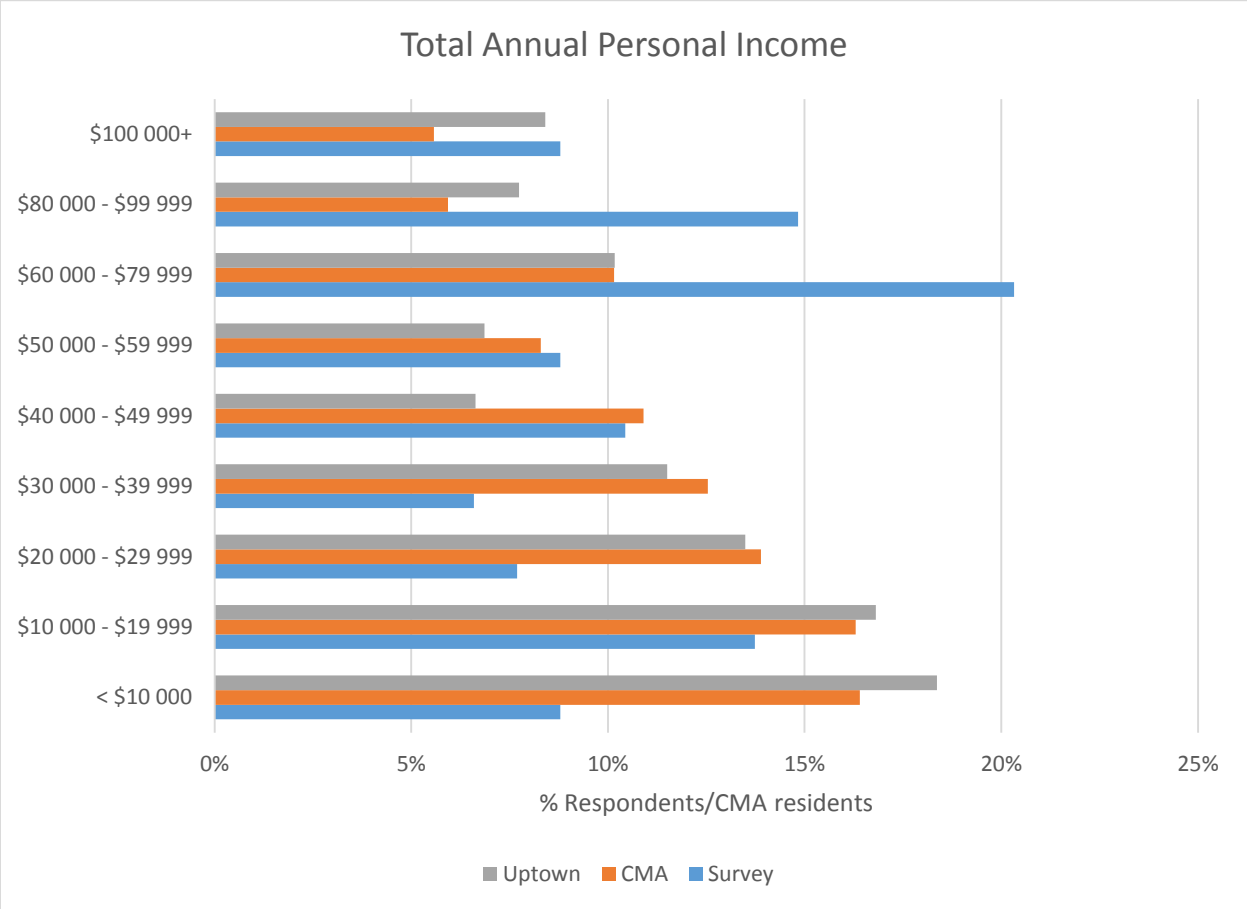

Figure 22: Total personal income distribution of Uptown census tract, Census Metropolitan Area, and web survey respondents (n=2 260, 365 200, and 182 respectively)

The employment characteristics of the survey respondents (as compared with NHS findings in Figure 23) do not precisely align with those of the National Household Survey due to the addition of "Other", "Student", and "Retired" categories and the omission of the NHS's "Not applicable" category. For the purposes of this analysis, the "Not applicable" group is paired with the Uptown survey's "Other" category, while the other NHS industry categories are compared directly to their equivalents in the Uptown survey. Bearing this in mind, there are striking distinctions between the employment compositions of the survey participants, residents of the Uptown census tract, and the Census Metropolitan Area.

Perhaps the most striking trend is the marked overrepresentation of employees in "education, law, social, community, and government services." 28.8% of survey respondents fell into that industry category, a nearly threefold increase from the Census Metropolitan Area's 10.8%. Although this speaks to the social demographics most drawn to Uptown's services, it is also representative of the employment opportunities in the Uptown area. In the Uptown census tract, for example, the proportion of residents employed in that industry category spikes to 23.1%, which speaks to Uptown's status as a political and social centre as well as the city's commercial core. Nevertheless, the survey participants' disproportionate employment in that professional category shows only moderate evidence ($p<0.1$) of an increase from the proportion of Uptown residents in that employment sector. These participants tend to be clustered around Uptown: as distance from Waterloo city square increases, the proportion of respondents in that category falls to a figure closer to the Census Metropolitan Area's average: 4 kilometres away from Uptown, the rate falls to 18% of participants and ceases to be a significant gap from the CMA average.

Several other sectors are significantly (at α=0.05) underrepresented among the Uptown survey respondents. "Management" accounts for 6.8% of participants compared to the CMA average of 10.5%; "Business, Finance, and Administration" 10.2% compared to 15.5%; "Health" 2.0% compared to 4.9%; all of which discrepancies fall beyond the 95% confidence interval for the proportions of the survey participants. Taken together, these indicate a shortage of respondents in broad sections of professional practice. This raises the concern that those fields gained less representation among the survey respondents because they had less exposure to the data collection procedures; however, it is entirely possible that the services offered by Uptown are proportionally less desirable to those groups.

Two underrepresented categories merit special mention. "Trades and transport" are all but absent among the survey participants despite being the third-largest employment sector in the CMA; and "Sales and services," the single largest sector in the CMA, accounted for only 5.4% of survey participants. Both differences are statistically significant at α=0.05. Given the ready availability of different forms of retail in the Uptown area, such low participation of those sectors is especially remarkable. However, it is consistent with previous evidence that mixed-use retail projects like Uptown Waterloo are visited relatively little by those whom they employ (Moos, Wilkin, et al., 2015). Niche, boutique, and high-end commercial space has less to offer those in the service industry, thanks in no small part to the comparatively low real wages offered by that industry. This is supported by the observation that, of participants employed in NHS industry groups, those in "Sales and services" reported the lowest wages of all respondents other than retirees and students, with a median of ~$30 000. Uptown is an atypical mixed-use infill project in that employees of those fields do in fact live nearby: 20.9% of the Uptown census tract's residents are employed in sales and services.

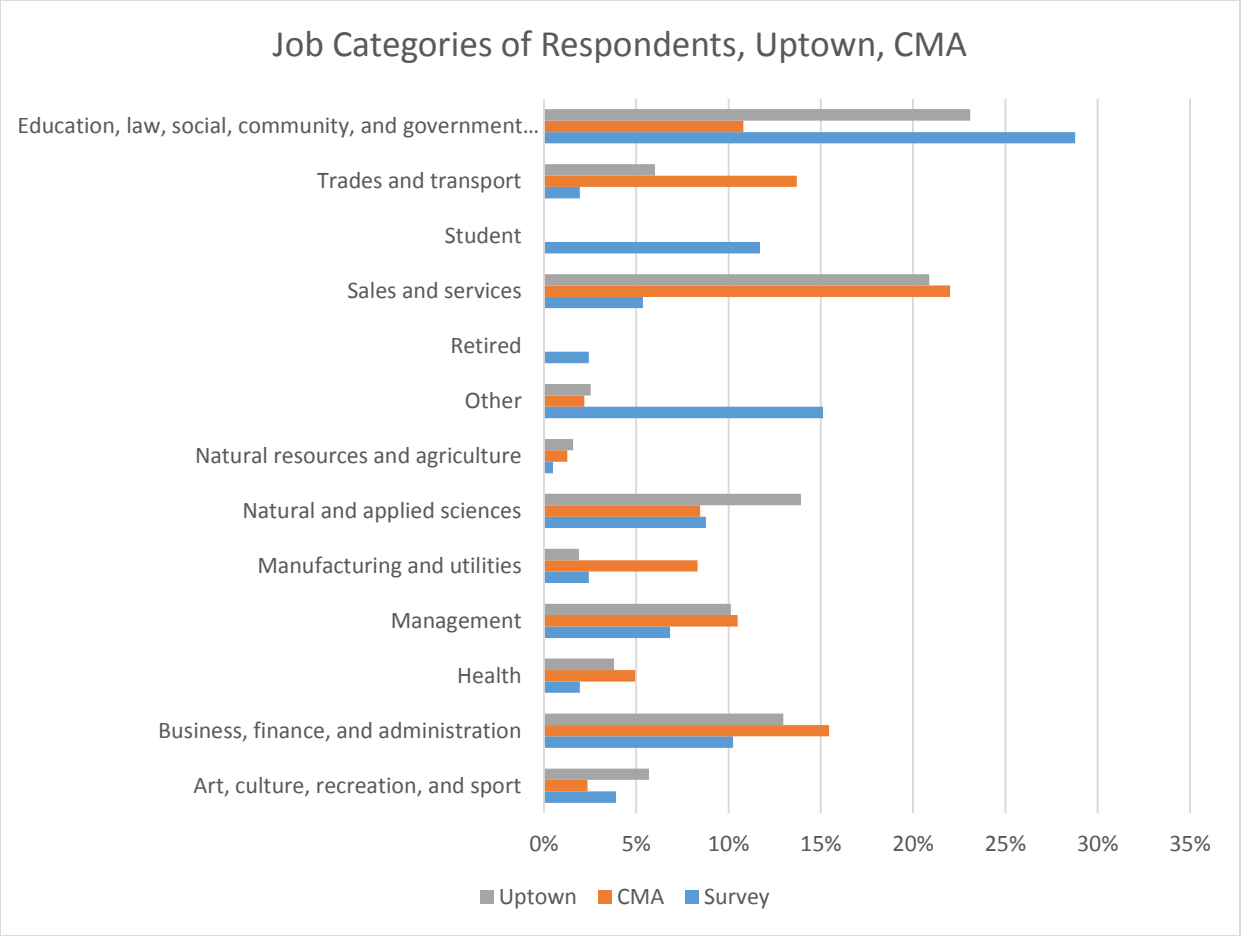

Figure 23: Employment by industry category of Uptown census tract, Census Metropolitan Area, and web survey respondents (n= 1 620, 267 460, and 205 respectively)

4.3.1.3 Income and Neighbourhood

While the incomes of the survey participants are well above average for the city, it is useful to estimate how typical they are of their more immediate neighbourhood. As such, respondent incomes are compared with the median incomes of their host census tract. If the respondents are average members of their neighbourhood with respect to personal income, then there should be direct positive correlation between the two variables. Linear regression shows no evidence of such a relationship ($p=0.7357$, $r^2 \approx 0$). Moreover, there is no evidence of a correlation between respondent incomes and the prevalence of low-income households ($p=0.4112$, $r^2 \approx 0$). In fact, the

median low-income prevalence for census tracts inhabited by respondents in the highest income bracket (18.0%) is second only to that of the lowest income bracket (18.6%). This trend defies the general negative association between high- and low-income households in the same census tract, indicating that Uptown draws a relatively affluent consumer base, even from lower-income and more economically mixed neighbourhoods.

4.3.1.4 Household

A majority of survey respondents (62.7%) live in single detached houses. The remainder are divided between semi-detached and row houses (17.4%), apartments (15.9%), and secondary suites (3.0%). There is moderate evidence (KW $p=0.075$) that this choice is related to age: those who live in single detached houses have the highest median age at 36, while apartment dwellers have the lowest at 29. There is no evidence (KW $p=0.4$) to suggest that the choice of living space is correlated to income level. A 66% majority of participants own their living space, a figure that rises to 82.8% for those who live in single detached houses. Rates of homeownership rise dramatically with age, with the 18-24 group the only one more likely to rent.

The survey participants are predominantly Canadian citizens and not members of visible minority groups. 4.9% of participants are permanent residents or other non-citizens, while 5.9% were visible minorities; the two groups are correlated (χ^2 $p\approx0$), but the eight participants who fall into both groups provide minimal predictive capacity. There is strong evidence of a preference for renting among participants in visible minority groups (χ^2 $p=0.013$) and moderate evidence of the same tendency among non-citizens (χ^2 $p=0.073$). However, there is no evidence that the visible minority status or Canadian citizenship of the participants are linked to income (Kruskal-Wallis $p=0.4655$ for visible minorities, $p=0.7166$ for citizenship). Nor there is evidence of a relationship between visible minority status (χ^2 $p=0.363$) or citizenship status (χ^2 $p=0.320$) and

the participants' housing types, though the small sample size of visible minorities and non-citizens makes the Pearson chi-square test unreliable for this purpose. Members of visible minorities did have a significantly lower median age than non-minorities (28.5 years vs. 34 years, Kruskal-Wallis $p=0.0036$); non-citizens' age distribution followed the same pattern, though not to a significant degree ($p=0.1779$).

The household types of the respondents can largely be compared directly to the NHS results; however, as the NHS does not address the topic of secondary suites, those survey responses have been added to the "Other" category. Also of note is that the census and National Household Survey tabulate household information by dwelling, not by respondent; in order to compare the two, this assumes one survey participant per household.

Survey respondents showed a preference for single-detached houses compared to the Census Metropolitan Area in general and Uptown in particular, as illustrated in Figure 24. 62.75% of participants reported living in single detached houses, a statistically significant gap from the 55.9% of CMA residents at $\alpha=0.05$. In other respects, the survey participants chose their dwellings in proportions similar to the CMA averages, except for a significant drop in the use of low-rise apartment buildings: 5.4% compared to an average of 13.3%. The Uptown census tract has markedly different proportions, in particular a 60% rate of use of apartment buildings and only a 23.5% use of single detached houses, in keeping with its design as a densified urban core.

Interestingly, participants' use of apartment buildings does not increase with proximity to Uptown; in fact, those living within 2km of Uptown are over 10% more likely to choose single detached houses than those living farther away (68.1% vs. 57.4%). Even among the respondents living in the Uptown census tract, a 57.8% majority have a single detached house for a dwelling.

This tendency merits closer investigation. Uptown's zoning planned for a density gradient at the periphery to smooth the transition into the surrounding neighbourhoods (City of Waterloo, 2014a), and the strong representation from residents of that edge zone indicates a group that appreciates both the personal space of a private lot and the accessibility of the mixed-use development. Uptown residents need not be condominium or apartment dwellers to be part of Waterloo's "urban heart".

Despite this preference for single homes, survey participants were more likely to rent their living space than the norm: 34.1% rented, compared to 29.8% of the CMA overall. This is almost certainly due to the participants' young ages relative to the CMA average: those seeking a starter home or a place to live early in their professional careers are more likely to rent their accommodations than to invest themselves in mortgages. Indeed, home ownership versus renting is a significant predictor of age among the participants (Kruskal-Wallis $p=0.0001$); the median homeowner is 37 years old, while the median renter is 28. Neither home type nor rental status, however, are predictors of the amount spent at Uptown (Kruskal-Wallis $p=0.90$ and 0.79, respectively).

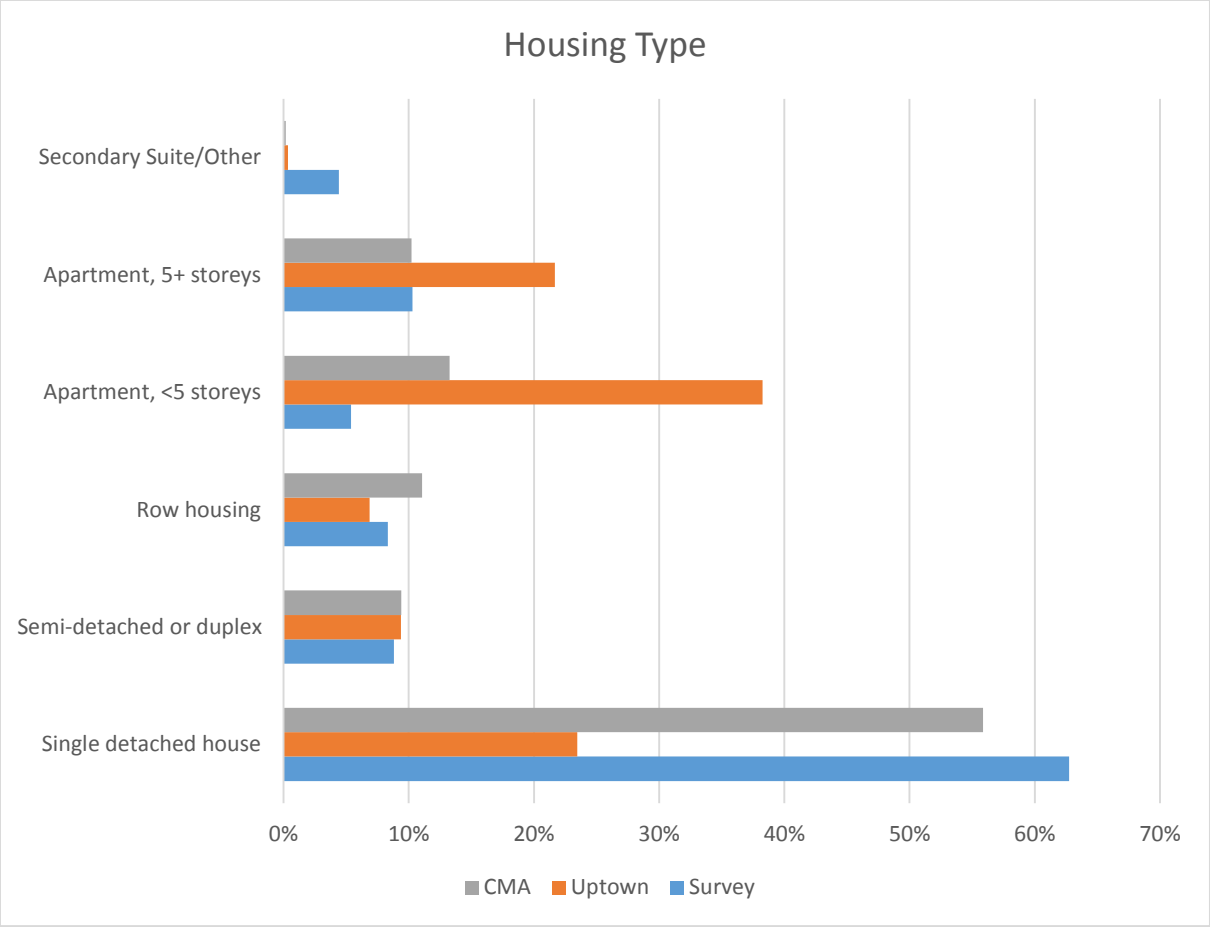

Figure 24: Housing type of CMA households, Uptown census tract households, and web survey respondents (n= 181 170, 1 385, and 198 respectively)

The rate of non-citizens among participants is similar to that of the CMA overall (4.8% vs. 5.3%, respectively). The proportion who are members of visible minority groups, however, are drastically lower than average for the Census Metropolitan Area. 16.2% of Kitchener-Waterloo-Cambridge residents and 10.7% of Uptown's population are of visible minorities, compared to only 5.7% of the survey respondents. That the visible minority presence is so much lower in Uptown than elsewhere in town and that it should fall lower still for those who shop there is cause for concern. It merits investigation into whether the lower attendance rate is due to matters of accessibility, competition, or, for example, a cultural homogeneity that does not include

desired services. Given that respondents from those groups tended to be younger and rent their homes, both favourable in the Uptown census tract, their lack of presence in Uptown is telling.

4.3.2 Social Stratification of Shopping Behaviour

- *Shopping frequency vs. age, gender, citizenship, and minority status*
- *Shopping frequency vs. income*
- *Shopping frequency vs. employment sector*

4.3.2.1 Compared to Demographics

Given the large proportion of Uptown shoppers who are of young professional age, it merits investigating whether different age groups among the survey participants visit Uptown more frequently than others. Constructing a linear model of age and shopping frequency is not supported ($p=0.88$), so the different age categories as used by the National Household Survey will be used for comparative purposes. Separating shoppers into those categories, the distributions of total monthly visits are non-normal according to very strong evidence from the under-45 age group (Shapiro-Wilk $p<0.01$ for all) and moderate evidence for the 45+ age groups (Shapiro-Wilk $p=0.19$).

Among the age groups with sufficient sample sizes to construct a distribution (i.e. the under-55 groups), the median number of monthly visits was 16 for the 18-34 age groups and 17 for the 45-54 age groups. Among the eleven members of the 55-64 age group, this number fell to 11.5, and further still to 7 for the 65+ group. However, there is no evidence (Kruskal-Wallis $p=0.873$) to suggest that these general trends are not due to error or chance.

There is little to no evidence to indicate that frequency of trips is influenced by gender (Kruskal-Wallis $p=0.25$), citizenship status ($p=0.75$), or status as a visible minority ($p=0.18$).

4.3.2.2 Compared to Income & Employment

There is no evidence to support the hypothesis that members of higher income groups visit Uptown more frequently, such as for the purposes of leisure shopping and activity. A cursory examination of the income categories' frequency distributions shows them to be quite similar, which is supported by the Kruskal-Wallis p=0.9805.

There is, however, preferential use of Uptown by people in particular categories of employment. Of the different employment options, those who visited Uptown most frequently were in Sales & Services and the ever-elusive Other category, both of which had a median of 21 monthly visits; followed by students at 20. Those who visited least frequently were in Manufacturing & Utilities at 6 monthly visits, retirees at 7, and Management at 8.5. There is strong evidence (Kruskal-Wallis p=0.034) that these gaps in average attendance are not due to chance.

That service workers should visit Uptown so frequently is likely explained by the fact that 36% of them travel there for work, a proportion second only to the four Health workers. Perhaps more surprising, given the concentration of "Education, law, social, community, and government service" jobs in the immediate area and the disproportionate number of respondents in that category, is the fact that their attendance was strictly average compared to other employment groups, as was the rate at which they traveled to Uptown for work purposes.

4.3.3 Reason to Visit

- *Primary reason to visit Uptown vs. income*

As Uptown is intended as a "live-work-play" zone as well as a commercial area, the different reasons people have for visiting the site merit consideration. Of the options provided in the survey, "studying", "home", and "other" garnered too few responses to analyse, while the other options drew sizeable sub-populations (see Figure 25). Among these remaining options, there appears to be an income gap. The median income of people arriving to Uptown for work is considerably higher than those who arrive for other reasons: $75 000 compared to $55 000 for the next highest group. While this is broadly suggestive of the shift towards well-paid quaternary jobs that is often accompanied by gentrification (Quastel et al., 2012), there is little evidence (Kruskal-Wallis $p=0.1162$) that this gap is not due to chance. The high rate of jobs in those employment categories (Education, law, social, community, and government services; and business, finance, and administration) is as pronounced among people who work at Uptown, though not to a significant extent at $\alpha=0.05$.

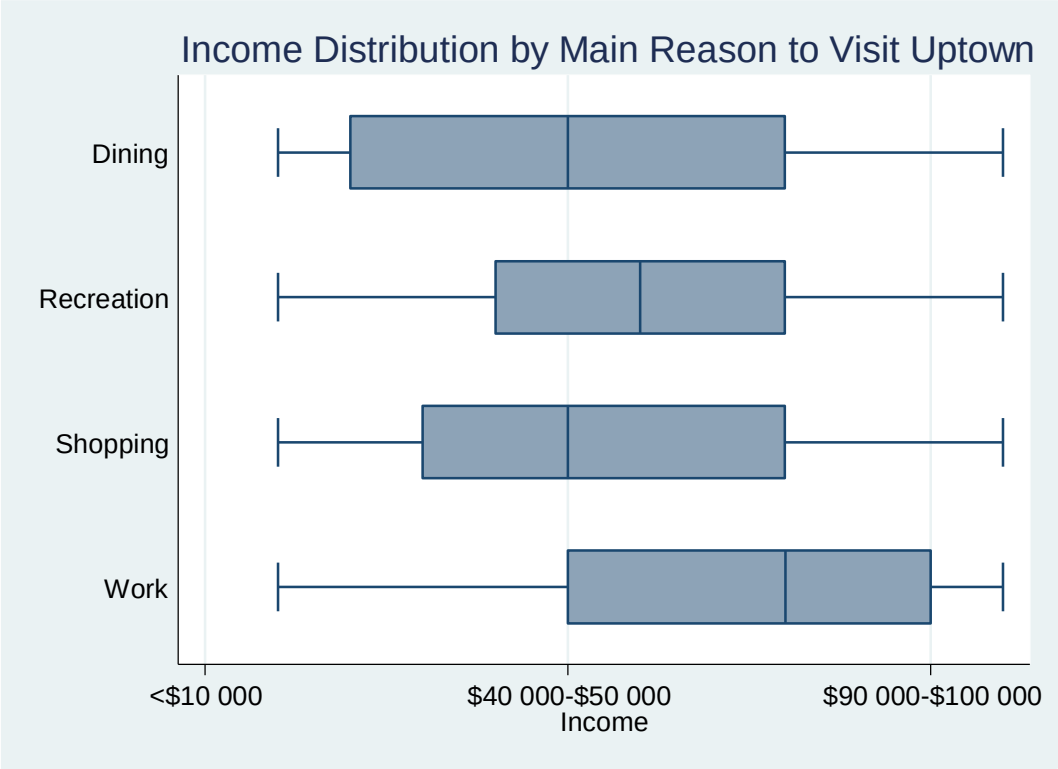

Figure 25: Income distribution of web survey respondents, by selected reasons for visiting Uptown (nDining=42, nRecreation=46, nShopping=65, nWork=24. 8, 2, 9, and 3 missing values respectively.)

5. Discussion

5.1 Limitations

When generalizing the study results, the methods of data collection must be taken into account as a potential source of selection and response bias. The research structure represents participants who were already visiting Uptown or who were sufficiently interested in Uptown to self-select on the web survey. As such, the study does not reveal how intensively Uptown's facilities are used by the general population of the Census Metropolitan Area. It does, however, illustrate the relationships between participant demographics, travel preferences, and purchasing patterns among Uptown shoppers. These relationships can be generalized to larger groups by being mindful of the relationships between demographics and travel behaviour displayed by the survey participants.

The in-person survey's means of soliciting responses has the potential for selection bias, although a comparison of the in-person and web survey participants' responses suggests that this did not significantly skew the findings. Quota sampling stressed obtaining sufficient responses from the different transit modes in a timely manner; the survey was primarily administered in the most heavily trafficked areas of Uptown, which neglected the areas farther away from Waterloo Town Square. Most of the in-person surveys were also administered on weekdays and during standard business hours, which underrepresents evening errands and leisure activities for people working those hours. That said, participants in the in-person survey did display a broad variety of shopping activities irrespective of the time of data collection: destination points like grocery and alcohol shopping drew visitors in similar patterns to those reported on the web survey, as did a broad range of "Other retail" options. The most marked distinction between the in-person survey and web survey respondents was the latter group's near-ubiquitous use of Uptown's

restaurants and cafés; the comparatively low rate of use of the same in the in-person survey suggests that local workers on their lunch or coffee breaks are not overrepresented. These trends suggest opportunities to investigate weekend leisure activities at Uptown, but indicate that the daytime shopping represented in the in-person survey can be generalized as a consumer group.

The web survey was distributed through university social media accounts and a transit newsletter issued by the City of Waterloo, both of which favour respondents with a pre-existing interest in these matters. Although several of the accounts to re-tweet the link represented pro-cycling or –environmental groups, the link was also shared by multiple news sites, whose followers presumably were not drawn to those elements of advocacy in particular. An interview on K-W CBC radio provided more exposure to a casual audience, and distribution via the City of Waterloo e-newsletter introduced the survey to a publicly conscious but not necessarily cycling-focused group. Though the respondents' demographics are inconsistent with the Census Metropolitan Area's, they are more closely matched by the Uptown area's with respect to their relative youth, predisposition for quaternary employment, and somewhat higher income. That lower income levels are underrepresented among the study could indicate selection bias, but could also be due to that demographic group's reduced rate of retailing activity relative to high-income households (Martens, 2013; Pucher & Renne, 2003).

Bearing that in mind, the atypical distribution of transportation modes can be interpreted as a valid representation of the relationship between retailing activity and transportation choices. The relative affluence of drivers is consistent with previous transportation studies (Stokes & Lucas, 2011); so is the broad income range of active transport users (Pucher & Renne, 2003), which includes those who use active transport for economic reasons (Butler et al., 2007) and out of personal preference (Heesch et al., 2014; Sustainable Development Commission, 2011). So it

is reasonable to interpret the skew towards sustainable transport modes – particularly among higher-income groups and those with other transport options available – as demonstrating that Uptown's structure and amenities are conducive to those transport modes, rather than an artifact of the data collection process.

The surveys were designed with a focus on people's behaviours as consumers; requests for personal information were kept to a minimum to reduce survey length and encourage responses. Factors like the number of adults and children in the household, the transportation options available to the participant, their educational level, and their status as head (or not) of the household are useful details when investigating people as consumers. For the purposes of this study, these considerations are addressed through their correlation with other sociodemographic measures of gentrification (Quastel et al., 2012), but a more in-depth inventory of shopping behaviours would do well to pursue those lines of inquiry explicitly.

Any generalization of the findings should take into account the metropolitan landscape of the Kitchener-Waterloo-Cambridge census metropolitan area. Although data collection protocols focused Uptown Waterloo to the exclusion of other retail spaces in the CMA, the distribution of commercial and residential zones plays an important role in shopping and recreational behaviour. The region's history of suburbanization and its recent recentralization initiatives are useful parallels to other mid-sized Canadian cities, although the unique push and pull factors in each city should be taken into account when drawing parallels (Bunting et al., 2007). Policy directives towards active transportation infrastructure and transit corridors (Brunt & Winfield, 2005) are particularly relevant to this study, providing a degree of connectivity to the core that offset an earlier tendency for traffic to skirt around it. Kitchener is also relatively homogeneous in terms of income and poverty distribution (Ross, 2004; Walks & Bourne, 2006),

being roughly average relative to other metropolitan areas. However, the other business hubs in the city, such as the peripheral malls and downtown Kitchener to the south, are draw factors that should be addressed in a more general model of commercial activity. These are joined by a slight late 20th century trend of higher-value development around the urban fringe (Pavlic & Qian, 2013). Overall, the core area containing Uptown is of middling density, in a metropolitan area that was shifting towards its periphery; the behaviour of Uptown shoppers should be weighed against those external influences.

5.2 Summary

The survey participants illustrate a consumer base for Uptown that is relatively young, affluent, and engaged in the knowledge economy; that makes extensive use of sustainable transportation methods when shopping; and that visits Uptown for a variety of recreational and commercial reasons. The findings suggest that Uptown is quite supportive of active and public transport, but that its patrons are members of the "new middle class" that are commonly associated with mixed-use revitalization projects as a gentrifying force. Table 2 revisits the questions posed in Section 1.4 with a summary of the research findings.

Over 70% of respondents most frequently used sustainable transportation methods to reach Uptown, favouring bicycles over all other transport modes, though public transit use was relatively underrepresented compared to respondents' general transportation preferences. Though mid-sized city centres are a comparatively weak draw on public transit users (Bunting et al., 2007), even modest densification discourages vehicle use (Cervero & Kockelman, 1997; T. A. Clark, 2013), whereas bicyclists favour downtowns (Bent & Singa, 2009; Popovich & Handy, 2014; Pucher et al., 1999). Pedestrians were clustered close around Uptown, while bicyclists and public transit users occupied a middle ground in average distance between them and drivers.

Aside from travel distance, active transport users were most markedly distinguished from drivers in their increased rate of visiting Uptown. Pedestrians, likely drawn to the easy proximity of convenience shopping (Clifton et al., 2013), visited most. The relative density of services (Casello & Rewa, 2011; Sundquist et al., 2011) is also appealing to bicyclists, the second most frequently visiting group. Despite these varied travel patterns, there was no appreciable gap in expenses between sustainable transport users and drivers, corroborating previous studies that found the groups' monthly spending to be comparable (Baker & Macdonald, 2006; Clifton et al., 2013; Popovich & Handy, 2014).

Concerns that more socioeconomically advantaged shoppers would make more diverse use of Uptown's transportation networks were not supported. While seniors and higher-income participants indicated a preference for personal vehicles, and personal vehicle use was negatively associated with the presence of low-income households, the active transport methods proved to be the most equitable in terms of the income and social groups using them. Other investigations (Baker & Macdonald, 2006; Butler et al., 2007; Casello, Nour, Rewa, & Hill, 2011; Clifton et al., 2013; Goodman, Sahlqvist, & Ogilvie, 2013; Pucher & Renne, 2003) disagree as to whether pro-active transport initiatives favour those who bicycle and walk due to financial restrictions or those who do so for recreational purpose; both groups are represented among the participants. The fact that active and public transport users visit from distinctly less affluent neighbourhoods than those who drive suggests that Uptown is, at least, reachable to more disadvantaged groups who wish to visit, although individual mobilities under straitened circumstances can be highly situational (Curl et al., 2011; P. Jones & Lucas, 2012).

The demographics of the survey participants indicate disproportionately high socioeconomic status relative to their neighbourhoods and to the city. The abundance of young,

well-paid, and quaternary-sector Uptown shoppers, relatively few of whom are immigrants or visible minorities, is consistent with the sociodemographics of a gentrifying area (Fong, 2000; Meligrana & Skaburskis, 2005; Quastel et al., 2012; Stokes & Lucas, 2011). Income distributions surrounding the Uptown area remain comparable to more distant neighbourhoods, and this trend towards affluence is dispersed across the city, but this group remains the core Uptown consumer demographic seen among the survey participants.

Table 2: Primary research themes, selected related materials, and findings

Variables	Question	Data Source	Literature Keywords	Authors	Findings
Most-used travel mode, Primary travel mode	Do people disproportionately use sustainable transport to reach Uptown?	Web Survey	Active transit-supportive infrastructure, dimensions of accessibility, branding sustainable transport	Bent & Singa (2009); Teller & Elms (2012); Banister (2011)	72.3% used sustainable transport. Primary drivers were more likely to use active transport to reach Uptown than vice-versa.
Travel distance	Is mode choice distance-dependent?	Web Survey, Postal Codes	"Walksheds", Transit-supportive infrastructure, transport demand management	Millward, Spinney, & Scott (2013); Cervero & Kockelman (1997); Pucher & Renne (2003)	Pedestrians were most spatially bounded and drivers the least, with bicyclists in the middle.
Travel time	Is mode choice dependent on travel time?	In-person survey	Urban density, public transit density, time- and route-based accessibility factors	Lenworthy & Laube (1999); Curl et al (2011); Filion et al (1999)	Travel times were consistent across travel modes.
Most-used travel mode, Frequency of trips	Do people visit more frequently by active transport than by vehicle?	Web survey	Positive experiential factors, accessibility by foot & bicycle	Heesch et al (2014); Popovich & Handy (2014); Handy & Clifton (2001)	Pedestrians and bicyclists visited almost three times as frequently as drivers. Travel distance weakly affects frequency for pedestrians and public transit users, but travel mode is a much stronger predictor.
Frequency of trips, Purpose of visit	Which visit types most frequently bring people to Uptown?	Web survey	Job & service centralization, recreational & purposeful shopping; accessibility by active transport	Santos et al (2010); Bent & Singa (2009); Filion (2009)	Work most frequently, then shopping, then dining.

Total spent, Most-used travel mode	Do sustainable transport users spend as much as drivers at Uptown?	Web survey, In-person survey	Expenses per visit, monthly expenses	Baker & Macdonald (2006), Clifton et al (2013)	No significant difference between total expenses across modes.
Businesses visited monthly, Most-used travel mode, Distance	Do sustainable transport users use Uptown for more diverse reasons than drivers?	Web survey, In-person survey	Transport mode and errand type	Clifton et al (2013); Handy & Clifton (2001); Turner (2007)	Active transport users visited more different destinations per month than drivers, with distance a weak negative influence.
Businesses visited per trip, Most-used travel mode, Distance	Do people trip-chain similarly at Uptown using different travel modes?	Web Survey, In-person survey	Trip chaining by drivers	Baldwin & Fagan (2007)	No significance difference in chaining behaviours by travel mode; trip chaining more popular at Uptown than in general.
Primary travel mode, Age	Are younger people more likely to use active transport?	Web Survey	Social dimensions of travel	Jones & Lucas (2012); Popovich & Handy (2014); Butler et al (2007)	Drivers and pedestrians were older than bicyclists, with public transit users youngest overall.
Primary travel mode, Income	Is travel mode choice linked to personal income?	Web Survey	Equity and accessibility; access to services	Stanley & Vella-Brodrick (2009); Pucher et al (1999); Martens (2013)	Public transit users had lower median incomes, drivers had higher, and active transit users had a broader distribution.
Most-used travel mode, Age	Is travel mode choice linked to age?	Web Survey	Vehicle dependency vs. public and active transit	McIntosh et al (2014); Jones & Lucas (2012)	Bicycling and public transit were more popular among younger respondents, while drivers were older on average and pedestrians most varied.

Most-used travel mode, Census tract median income, CT low-income prevalence, distance	Is travel mode choice linked to neighbourhood affluence?	Web Survey, Census	Residential self-selection and travel preferences, transport wealth & gentrification	Schwanen & Mokhtarian (2005); De Vos et al (2014); Cao, Mokhtarian, & Handy (2009); Dodson et al (2004)	Drivers' home census tracts have the highest median income and lowest low-income prevalence, significantly but negligibly correlated to distance from Uptown.
Number of travel modes, Income, Age	Are income or age correlated with more varied use of transport modes?	Web survey	Incentives & disincentives to transport use, transport wealth & poverty	Heesch et al (2014); Jones & Lucas (2012); Stokes & Lucas (2011)	There was no link between income or age and the number of modes used to reach Uptown.
Respondent age & income, Census age & income distributions	Do Uptown shoppers have comparable ages & incomes to the general population?	Web Survey, Census	Sociodemographics of "new middle class"	Bartlett (2003); Quastel et al (2012)	Respondents were much more likely to be young adults and/or wealthy, while seniors, children, and the low-income were underrepresented.
Respondent job type, census job distribution	Are Uptown shoppers drawn from particular employment categories?	Web Survey, Census	Beneficiaries of revitalization, "new middle class"	Quastel et al (2012), Meligrana & Skaburskis (2005)	Education, law, social, community, and government jobs were much more common; while trades, sales & services were underrepresented.
Income, CT median income	Are Uptown shoppers' incomes representative of their neighbourhoods?	Web Survey, Census	Retail & residential gentrification	Meligrana & Skaburskis (2005); Stokes & Lucas (2011); Quastel et al (2012)	There is no relationship between respondents' incomes and their census tracts' median incomes.

Dwelling type, minority status, citizenship, home ownership	Are Uptown shoppers' households representative of their neighbourhoods?	Web Survey, NHS	Social upgrading & residential landscape	Meligrana & Skaburskis (2005), Quastel et al (2012)	Visible minorities were underrepresented. Respondents preferred detached houses, even in central neighbourhoods.
Age, gender, citizenship, minority status, income	Do different demographic groups of shopper visit more frequently?	Web Survey, NHS	Inclusivity/exclusivity of core amenities	Martens (2013), Fong (2000)	No significant link between age, gender, citizenship status, minority status, or income and frequency of visits was found.
Reason to Visit, Income	Are people who work at Uptown more affluent than those who visit for other reasons?	Web Survey	Mixed-use centre workers vs. visitors	Luederitz et al (2013); Filion & Bunting (2000)	No significant relationship was found.

5.3 Conclusions

There is strong evidence that Uptown has come to support a wide range of shopping, business, and leisure activity by encouraging the use of active transportation, if with the side effect of attracting a consumer base whose composition is generally indicative of a gentrifying neighbourhood. The even spread of transportation modes among the survey participants, particularly the fact that personal vehicle drivers are in the minority, speaks well to the City's goals of using Uptown to encourage use of the bus systems and walking and bicycling trails, while retaining some support for those who drive. The broadly equivalent spending patterns of these different groups at Uptown's facilities suggest that these transportation-based goals will not be detrimental to the region's businesses, and could in fact encourage more diverse spending activity in the consumer base. As befits a regional commercial core, residents both from nearby and from across the metropolitan area were observed to make use of Uptown's amenities, both for small-scale convenience shopping and more purposeful trips. While the sociodemographic profile of the participants does suggest a shift towards a pro-gentrification market, the economic activity of those people was not so markedly different as to undermine Uptown's mandate to serve all the different groups in the region.

As a mixed-use centre, Uptown's presentation of niche businesses anchored by staple stores encourages its use as a commercial node by people of all neighbourhood and transit types (Baker & Macdonald, 2006; Filion, 2009). From the ten-minute walk typical of the pedestrian catchment to the leisure bicycling dispersed throughout the city, customers displayed a marked tendency to visit Uptown for multiple purposes per visit as well as throughout the month. The relatively low rate of bus use in spite of its core location (Baker & Macdonald, 2006), however, is suggestive of a public transit system that will benefit from the upcoming transportation plan's

reinvestment and multimodal integration (Pucher & Renne, 2003) – as will the comparably low-income people who use it. As is common (Pucher & Renne, 2003), travel by bicycles was distributed both across different neighbourhoods and different income groups; they are used both by the young, well-off, and active out of personal preference and the lower-income groups who bicycle for necessity (Butler et al., 2007; Stokes & Lucas, 2011). The broad range of participants to use active transport is especially noteworthy: high-income pedestrians counter the general tendency of affluent households to walk less (Santos et al., 2010), while low-income bicyclists demonstrate that Uptown encourages cycling among other groups than the higher-than-average earners who typically cycle in Waterloo (Casello & Rewa, 2011).

Activity within Uptown showed several trends that held across the travel modes. Contrary to the concerns of some business people (Popovich & Handy, 2014), people arriving by active transport showed no reduction in overall spending compared to drivers, and indeed were sometimes observed to outspend those who came by car. Bicyclists and pedestrians did, however, visit Uptown markedly more frequently than drivers were observed to; though this could be attributable to the immediate accessibility of Uptown to nearby pedestrians, it also reflects the greater freedom of those groups to make spontaneous trips to convenience shopping, local centres, and food establishments (Clifton et al., 2013). That they have the same inclination to visit multiple businesses, both on individual trips and throughout the month, is an effective counter to occasional concerns (Bartlett, 2003) that neighbourhood oriented specialty retail cannot secure its own consumer base. Going by the survey respondents, Uptown is highly accessible to casual visitors, and profits as well by them as by more purposeful shoppers.

Despite the overall high socioeconomic status of the respondents, sustainable transportation modes were demonstrated to be equally accessible to low- and high-income

participants alike. Although public transit attracted a lower average income overall, bicyclists and drivers from across the city displayed an extremely heterogeneous composition. Drivers did display a reduced tendency to employ other transit options, but while this is sometimes a sign of lower-income families forced by transport poverty to rely on a car (Stokes & Lucas, 2011), no such relationship with income was found here.

Survey participants leaned strongly towards indicators of high socioeconomic status; although these indicators are common drivers of gentrification, this tendency was not concentrated in any particular area. A trend towards younger quaternary-sector employees was observed, which generally indicates a social restructuring towards a more affluent neighbourhood (Bagley & Mokhtarian, 2002; Meligrana & Skaburskis, 2005). That such a shift might begin next to a new, intensified, mixed-use revitalization project is unsurprising (Bagley & Mokhtarian, 2002; J. Clark & Kearns, 2012; Koster & Rouwendal, 2012), but it is also observed in more distant neighbourhoods that do not benefit from the immediate spillover value of the new real estate (Song & Knaap, 2004).

In this respect, the policy goal to increase housing and jobs density in the Uptown core should be tempered with an eye for equity. Densification in its own right has been observed to increase the amenity of the neighbourhood and advance environmental goals, but also makes the area less affordable to people living within, especially renters and lower-income households (T. A. Clark, 2013). As such, using densification as the primary metric of urban sustainability is an oversimplification that benefits a specific sociodemographic group at the cost of diminishing the presence of the less fortunate (Bramley & Power, 2008; Quastel et al., 2012). Even pro-density Smart Growth principles suggest a variety of compact, alternative housing forms (Duany &

Speck, 2010) that can mitigate this trend; it is advisable that the composition of incoming housing be regulated to provide options for different social groups and income levels.

This concern is amplified by Uptown's status as a mixed-use project in Waterloo's core. Central developments of this nature are major branding efforts for a city, and are designed with an eye for the experience of visiting it. Consequently, while the residential space is tugged towards the higher-value, many of the jobs being added are lower-wage service positions. The near-total absence of service workers among the respondents, compared to their presence in the Uptown census tract, reveals the outcome: while mixed-use centres provide enjoyable living environments for high-income, often quaternary workers, the service employees also employed at the site are priced out (Moos, Wilkin, et al., 2015). Since Uptown is designed with a density gradient to merge into the surrounding neighbourhood, it is a worthwhile exercise to incorporate affordable housing quotas so that the "Live, Work, Play" promise of Uptown is available to a broad range of its employees.

These issues notwithstanding, Uptown has shown great promise in promoting sustainable transportation methods among a wide variety of users. As a key component of the region's plan to do so, its friendliness to pedestrians and bicyclists should be investigated and maintained throughout the site's development. The weight of perceived barriers and incentives to active transport makes it especially valuable to take stock of conducive streetscape features (Bagley & Mokhtarian, 2002; Casello & Rewa, 2011; CNU, 1996; Spokane et al., 2007). Meanwhile, the upcoming light rail line expansion presents an opportunity to extend that positive image to the public transit system, a need that is illustrated in particular by the low turnout and personal income of public transit users in the survey.

Overall, then, Uptown flirts with the processes of gentrification without unduly advancing them, but care should be taken to ensure that ongoing development processes do not shift this balance. The older, inner neighbourhoods nearby are important to the affordability of the city: equitable transit accessibility can most easily be secured through them, but they are also prone to appropriation and displacement, granting their favourable location to those who do not need an additional transportation advantage. Core intensification projects should be planned with these blends of incomes, demographics, and accessibility needs in mind (Luederitz et al., 2013). As favourable as Uptown's location and accessibility are, its profile of shoppers is a reminder of that imperative. If the central city is to be reclaimed and revitalized, it should not be at the expense of those who could benefit most closely from its growth.

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Appendix A – In-Person Survey

1. How did you travel to Uptown today?
   - Bicycle
   - Personal vehicle
   - Public transportation
   - On foot
   - Other (Please specify)

2. How long was your trip to Uptown?
   Please estimate the number of minutes you spent in travel: (0-60+)

3. Where did you travel from?
   - Work
   - Home
   - Other shopping
   - Other

4. While at Uptown today, what businesses do you plan to visit or have visited already?
   Please select all the categories that apply:
   - Grocery
   - Clothing & Footwear
   - Furniture
   - Alcohol
   - Home & Garden
   - Other retail
   - Pharmacy
   - Movies & Entertainment
   - Banking
   - Restaurant
   - Café
   - Other services

Appendix B – Online Survey

1. In an average month, approximately how many times do you visit Uptown Waterloo?
2. In the past month, how many times have you visited Uptown using the following methods of transportation:
   Bicycle:
   Personal vehicle:
   Public transit:
   On foot:
   Other:
3. In the past month, which of the following businesses have you visited in Uptown? Please select all the categories that apply:
   - ○ Grocery
   - ○ Clothing & Footwear
   - ○ Furniture
   - ○ Alcohol
   - ○ Home & Garden
   - ○ Other retail
   - ○ Pharmacy
   - ○ Movies & Entertainment
   - ○ Banking
   - ○ Restaurant
   - ○ Café
   - ○ Other services
4. In the past month, what was your main reason for visiting Uptown?
   - ○ Work
   - ○ Shopping
   - ○ Dining
   - ○ Studying
   - ○ Recreation
   - ○ Other
5. On your last trip to Uptown, how much money did you spend at each of the following businesses?
   - ○ Grocery: _____
   - ○ Clothing & Footwear:
   - ○ Furniture: _____
   - ○ Alcohol: _____
   - ○ Home & Garden:__
   - ○ Other retail: _____
   - ○ Pharmacy: _____
   - ○ Movies & Entertainment: _____
   - ○ Banking: _____
   - ○ Restaurant: _____
   - ○ Café: _____
   - ○ Other services: _____
6. Do the businesses you visit most in Uptown have sufficient bicycle parking nearby?
   - ○ Yes
   - ○ No
   - ○ Not sure
   - ○ Other

7. What is the greatest challenge to visiting Uptown by bicycle?
   - ○ Traffic ○ Lack of bicycle parking
   - ○ Carrying purchases ○ Lack of bicycle lanes
   - ○ Distance ○ Exertion
   - ○ Weather ○ Other:

Travel Habits

8. Overall, what is your primary mode of transit?
   - ○ Walking
   - ○ Bicycle
   - ○ Public transit
   - ○ Personal vehicle
   - ○ Other:

9. On average, how long does it take you to reach Uptown from home using your primary mode of transit?
   Please estimate how many minutes you spend in travel:

10. When you visit Uptown, where are you most frequently coming from?
    - ○ Work
    - ○ Home
    - ○ Other shopping
    - ○ Other:

Your Household

11. What is your home postal code?
    This helps us understand the road conditions in your neighbourhood.

12. What is your age?

13. What is your gender?
    - ○ Male
    - ○ Female

14. What is your current primary job?
    Please select the category that best describes your position.
    - ○ Management
    - ○ Business, finance, and administration
    - ○ Natural and applied sciences
    - ○ Health
    - ○ Education, law, social, community, and government Services
    - ○ Art, culture, recreation, and sport
    - ○ Sales and services
    - ○ Trades and transport

- ○ Natural resources and agriculture
- ○ Manufacturing and utilities
- ○ Retired
- ○ Student
- ○ Other

15. What is your total individual income?
    - ○ < $10 000
    - ○ $10 000 - $19 999
    - ○ $20 000 - $29 999
    - ○ $30 000 - $39 999
    - ○ $40 000 - $49 999
    - ○ $50 000 - $59 999
    - ○ $60 000 - $69 999
    - ○ $70 000 - $79 999
    - ○ $80 000 - $89 999
    - ○ $90 000 - $99 999
    - ○ $100 000+
    - ○ Prefer not to answer

16. Are you a member of a visible minority group?
    - ○ Yes
    - ○ No

17. Please indicate your citizenship status.
    - ○ Canadian citizen
    - ○ Permanent resident (immigrated in the past 5 years)
    - ○ Permanent resident (immigrated more than 5 years ago)
    - ○ Refugee
    - ○ Tourist

18. What type of housing do you live in?
    - ○ Single detached house
    - ○ Semi-detached or duplex
    - ○ Row housing
    - ○ Secondary suite in house
    - ○ Apartment in building with fewer than 5 storeys
    - ○ Apartment in building with 5 or more storeys
    - ○ Other:

19. Do you own or rent your housing?
    - ○ Own
    - ○ Rent