HOW LOCAL IS MAIN STREET? AN ANALYSIS OF NON-WORK RELATED TRIPS TO FOUR COMMERCIAL STREETS IN MONTRÉAL

November 11, 2008

Prepared for the Transportation Research Board 88th Annual Meeting

4566 words
8 figures and tables

Paul R. Tétreault
Master's student, School of Urban Planning, McGill University, Suite 400, 815 Sherbrooke St. W., Montréal, Québec, H3A 2K6, phone: 514-398-4075, fax: 514-398-8376, e-mail: paul.tetreault@mail.mcgill.ca

Ahmed M. El-Geneidy
Assistant Professor, School of Urban Planning, McGill University, Suite 401, 815 Sherbrooke St. W., Montréal, Québec, H3A 2K6, phone: 514-398-8741, fax: 514-398-8376, e-mail: ahmed.elgeneidy@mcgill.ca

ABSTRACT

With increasing concern about global climate change and sustainable development, local shopping in pedestrian friendly environments has been promoted as a strategy to reduce travel distances and increase the use of sustainable transportation modes. The resurgence of central neighborhoods and traditional commercial streets has led to livelier streets. Accordingly, an understanding of the current travel pattern to traditional neighborhoods is important for transportation planners, designers and decision-makers, to help them in designing and promoting commercial settings that can reduce trip distances and encourage sustainable transport. This paper focuses on non-work related trips to four traditional main streets in Montréal, Québec, Canada. We use the Montréal Origin and Destination survey to model each individual trip to the studied streets. Three linear regression models are generated to investigate factors influencing trip length for auto users, transit users and pedestrians and cyclists. Different factors are found to have influences on trip distance for users using different modes. For auto users it is found that neighborhood characteristics, trip purpose and type of destinations have an influence on trip distance. This can be contrasted to pedestrians and cyclists, where the destination has a little influence on distance but personal characteristics are found to be the main determining factor. For transit riders, distance is affected by their accessibility to service, activities at destination and personal characteristics. Findings in this paper can help land use and transportation planners and decision-makers in understanding the factors leading to a reduction of trip distances and attracting more nearby customers to main commercial streets.

HOW LOCAL IS MAIN STREET? AN ANALYSIS OF NON-WORK RELATED TRIPS TO FOUR COMMERCIAL STREETS IN MONTRÉAL

INTRODUCTION

With increasing concern about global climate change and sustainable development, local shopping in pedestrian and cyclist friendly environments has been promoted as a strategy to reduce travel distances and increase the use of more sustainable transportation modes. Traditional neighborhoods are mostly built prior to the surge in automobile use. Accordingly, most trips to commercial streets in these neighborhoods used to come from nearby districts using walking, cycling and transit. With the resurgence of some traditional commercial streets, there is a distinct possibility that revitalized streets might attract users from further away. In addition, these traditional neighborhoods are attracting auto users. Accordingly, an understanding of current travel pattern to traditional main streets is important for transportation planners to help them in designing and promoting these commercial settings in a way that can affect trip distances. The resurgence of commercial streets did attract some businesses that not only cater to local clienteles such as high-end restaurants, nightclubs or boutique stores.

This study looks at non-work related trips that were made to four separate traditional commercial streets in Montréal, Québec, Canada. Traditional commercial streets are important in providing services and opportunities for residents as well as having economic potential (1). The main goal of this study is to determine what factors influence the length of trips to a sample of four traditional commercial streets. It is assumed that longer trip distances are less sustainable than shorter ones. The study of non-work related trips is important because many users may have more flexibility in the short-term to change their travel behavior than is the case for work trips (2). Around 60% of all trips being recorded in the Montreal Origin and destination survey were non-work related (3). Of course, the redesign of streets is a long-term process rather than a short-term one.

This paper starts with a literature review on local shopping and non-work travel behavior, followed by a description of the study area and research methodology. Analyses of factors influencing travel distance by mode are introduced in the following section. Finally, the paper ends with a conclusion and recommendation section.

LITERATURE REVIEW

Shopping choice

The decision to shop at one location or another has been studied considerably. Holton (4) established the difference between “convenience” goods that are purchased frequently and “shopping goods” for which consumers’ effort of comparison shopping is worthwhile. Accordingly, consumers would be more willing to travel for shopping goods than convenience goods. Research has also focused on factors influencing the store choice. Carpenter (5) found that many objective and subjective variables affect the selection of a grocery store. In addition, he found that cleanliness, price, product selection, courtesy of personnel and security affect the selection of a grocery store, in addition to demographic variables such as income. In an analysis of trips to shopping centers, Arentze (6) found, in addition to the size and location, that the greater diversity of retail opportunities that is present in shopping centers has an effect on increasing the attractiveness of the location for multiple and single purpose trips even if no purchases are made in the other categories. Arentze hypothesizes that this is due to the attractiveness of the shopping centre, familiarity, loyalty and pleasantness of the shopping environment.

Urban form and non-work travel

A number of studies have looked at links between urban form and shopping. Cervero (2) compared two neighborhoods in the San Fransisco-Bay Area and found that residents of a “more compact, mixed-use and pedestrian-oriented neighborhood” are more likely to walk, bike or take transit than a suburban area controlling for transit use and income. In another study by Limanond (7) concentrating on trip generation to shopping in three traditional districts, it is found that the built form did not have an impact on the number of trips generated, yet residents living in traditional neighborhoods make many one-stop shopping trips. Krizek (8) found that residents in communities with high accessibility still do the majority of their non-work related trips outside of their neighborhoods. This finding contradicts with other claims that areas with higher accessibility are attracting more local trips.

Travel distance and mode choice

Recently, others have found that travel has a positive utility for many users. Mokhtarian (9) found that on top of demographic variables, subjective variables such as travel liking and travel stress were good indicators for predicting the distance travelled. Handy & Clifton (10) found that local shopping does not necessarily decrease automobile use but residents value the option of not driving. Handy (11) found that what can reasonably be concluded is that: "new urbanism strategies make it easier for those who want to drive less to do so." In a review of literature, Clifton (12) found that "trip lengths are primarily a function of the built environment and second a function of socio-economic characteristics."

Given the reviewed literature, there is currently a gap in the analysis of trips to traditional commercial streets. This paper attempts to provide further knowledge about types of travelers coming to these streets, where they are coming from, which mode they are using and what is affecting their distance of travel. Traditional commercial streets, especially in Montréal, have a large number of people residing within walking distance from them and a diversity of businesses is present in these streets. Accordingly, we expect that users of these streets have different factors affecting their travel behavior compared to travelers going to shopping centers and/or grocery stores. This study is also different since it analyzes trips to specific destinations, traditional commercial streets, instead of analyzing the travel behavior of users living in a particular neighborhood type.

CASE STUDY

Montréal has more than 40 traditional commercial streets (14) which present a great opportunity for studying commercial corridors. Four streets were selected based on several criteria. The first was the number of non-work related trips going to each traditional commercial street in the region. This information is obtained from the Montréal origin-destination survey (O-D survey). The O-D survey is a metropolitan survey that is conducted every five years in the Montréal region (*3*). The O-D survey includes disaggregate trips that were made by each person residing in a household that is included in the survey. The survey includes 5% of all households in the Montréal Region. The second street selection criterion is the presence of a business improvement association, which works towards attracting more people. Also, our criteria includes the number of businesses, the mix of shops, the location relative to other streets studied, the quality of the pedestrian environment and the location outside the core of downtown Montréal. The selected streets are avenue de Monkland in Notre-Dame-de-Grace, rue Ontario in Hochelaga-Maisonneuve, boulevard Saint-Laurent in the Plateau-Mont-Royal and rue Saint-Hubert in Rosemont-la-Petite-Patrie. The selected streets are shown in Figure 1.

(Insert Figure 1 around here)

Avenue de Monkland is located in the Notre-Dame-de-Grâce neighborhood to the west of downtown and has a mix of cafés, grocery stores and local shops. Rue Ontario is known as "Promenade Ontario." Rue Ontario has more than 145 businesses in the studied section in a number of business categories. Boulevard Saint-Laurent is in the gentrifying Plateau-Mont-Royal borough. It is known locally as "The Main" has along which many upscale and trendy shops have opened in the past decade. Saint-Laurent could be characterized as much more vibrant than the other streets due to its nightlife. Saint-Laurent has several bars, nightclubs and coffee shops open until at least 3 am. Rue Saint-Hubert is to the north-east side of downtown and has a concentration of clothing and bridal shops. Further information on these streets is given in table 1.

(Insert Table 1 around here)

By using business surveys from Dun & Bradstreet, the types of businesses present on each street were established. Only establishments that were deemed to be catering to non-work travel were taken into consideration. In other words, businesses such as manufacturers or movie production companies that are unlikely to attract non-work related travel were excluded. Monkland and Ontario had a greater proportion of shops that generally cater to local needs such as food shops, newsstands, convenience stores and drug stores. Saint-Laurent and Saint-Hubert seemed to have more establishments that would cater for shopping goods as defined by Holton (4). In addition to having more establishments such as clothing shops, Saint-Laurent and Saint-Hubert had a much higher density of businesses (212 and 222 businesses/km respectively) than Monkland and Ontario (121 and 148 businesses/km for Monkland and Ontario respectively).

DATA

The goal of this research is to understand the factors leading to longer travel distances for non-work related trips to traditional commercial streets. The O-D survey is one of the best data sources to achieve this goal. The O-D survey contains recorded trips based on the previous weekday's reported travel with all members of a household during the fall of 2003 and the early winter of 2004. Characteristics of the individual (age, sex, possession of a driver's license), the household (location, size) and the trip (purpose, mode, start time, origin and destination) are also available. The caveats of using this survey are that trips done by visitors to the region are not recorded. Another problem associated to this survey is that weekend trips are not included, which is disadvantageous since much non-work travel occurs on weekends. Cycling trips are also not as frequent at the time of year when the survey was conducted.

The selection of analyzed trips was based on whether users visited one of the four studied street segments. The selection was refined by only keeping trips that were made by users over 18 years of age and for all purposes except for work and return to home trips. Since the area covered by the survey is larger than the Montréal metropolitan area and thus these areas are not subdivided into census tracks, these trips were also excluded. A total of 774 trips are used in the analysis, each trip is identified with an origin, a destination, and the place of home of the traveler.

The second data source needed to generate distances in a GIS environment is an adequate network. Street centerline file and transit networks were obtained from DMTI and the Montréal Transit Corporation respectively. The same street centerline files are also used in the cycling and pedestrian while removing the freeways from the dataset. The third data source is businesses information on the destination streets obtained from Dun and Bradstreet. Only businesses that would likely cater to non-work related travel are retained when characterizing the streets. For example, shops, art galleries and restaurants are selected but movie producing companies and architecture firms are not. Also, the number of bus stops within a walking distance of 400 meters is counted for each origin and home, this information is essential for transit users. Demographic information is collected from the 2001 Canada Census on the users' home census tract. Two data points were excluded due to the absence of information related to the median household income in the census.

Finally, since the businesses are geographically coded to every block face and identifying each destination along each street segment is possible, the streets are separated into 21 street segments. These segments varied from 150 to 300 meters in length. The relative diversity of the street segment is then calculated by counting the number of business categories, using the North American Industry Classification System (NAICS) represented on each street segment divided by all of the business categories present on all four streets. This relative diversity was then associated with users that visited each particular street segment since the exact establishment visited by the user is unknown. For the purpose of the analysis, all variables are displayed in Table 2.

(Insert Table 2 around here)

METHODOLOGY

Modeling auto, transit, bicycling and pedestrian behavior requires having a separate network for each mode and different criteria for calculating the distance. Figure 2 shows an example of modeled routes from several origins to various destinations along Monkland Avenue. These routes represent the shortest travel time for auto based on the posted speed limits. For transit the modeling is made based on a shortest walking distance to the nearest stop followed by a boarding at a transit station then an alighting at the nearest stop to the destination then walking towards the destination along the shortest path. This process is done using a geographic information system software package, ArcGIS. There were pitfalls with the car network since there is no elevation data available and thus overpasses, underpasses and interchanges are treated as intersections in the analysis. Also, delays due to traffic signals were not modeled since the information was unavailable. The transit network is also limited due to the absence of information on the frequency of service.

(Insert Figure 2 around here)

This study uses the trip as the unit of analysis. There are two ways of looking at the travel distances. The first is visually observing the dispersions of the origins in the region and by generating distance decay curves. The second is by using statistical analysis. The statistical analysis allows the identification of the effects that personal characteristics, trip characteristics and destination characteristics have on the travelled distance while controlling for other external variables. In order to analyze these factors, four regression models are generated: one for auto users (drivers and passengers), another for transit users, the third is a combined pedestrian and cyclist model and another model combining all modes. Although, cyclists travel much longer distances than pedestrians, they were combined to pedestrian trips because of the relatively few recorded bicycling trips. The small number of trips is probably due to the time of the year during which the survey was conducted (fall and winter 2003 and 2004). The following linear ordinary least squares models were generated:

1. Distance travelled (car users) = f(sex, age, number of trips, shopping trip dummy, entertainment dummy, home start dummy, AM trip start dummy, PM trip start dummy, Saint-Laurent dummy, Saint-Hubert dummy, Ontario dummy, Median household income, Diversity index)

2. Distance travelled (transit users) = f(sex, age, number of trips, shopping trip dummy, entertainment dummy, home start dummy, AM trip start dummy, PM trip start dummy, Saint-Laurent dummy, Saint-Hubert dummy, Ontario dummy, Median household income, Diversity index, Number of transit stops within 400 meters of home)

3. Distance travelled (pedestrians and cyclists) = f(sex, age, number of trips, shopping trip dummy, entertainment dummy, home start dummy, AM trip start dummy, PM trip start dummy, Saint-Laurent dummy, Saint-Hubert dummy, Ontario dummy, Median household income, Diversity index, Cyclist dummy)

4. Distance travelled (all modes) = f(sex, age, number of trips, shopping trip dummy, entertainment dummy, home start dummy, AM trip start dummy, PM trip start dummy,

Saint-Laurent dummy, Saint-Hubert dummy, Ontario dummy, Median household income, Diversity index, Transit User dummy, Pedestrian dummy, Cyclist Dummy)

All models incorporate the same base variables. One variable is added to each of the pedestrian cyclist model (cyclist dummy) and the transit model (number of bus stops within 400 meters of home). It is expected that the age, shopping and entertainment trips, morning trips, trips to Saint-Laurent, Saint-Hubert and Ontario, the median household income of the home neighborhood and the diversity will increase travel distances. It is also expected that the number of trips will decrease the trip distance. For transit users, it is expected that users with higher transit accessibility will travel shorter distances. It is also expected that cyclists will travel considerably longer distances than pedestrians. The models could have also incorporated other street characteristics such as the business density or neighborhood characteristics such as population density but these were correlated with the diversity index (positive) and the median household income (negative).

ANALYSIS

In order to understand the data we have in hand, distance decay curves were generated. Figure 3 shows the distance decay curve for each mode. The distance decay figures also incorporate best-of-fit lines for each category. As would be expected, the mode has a large influence on the length of non-work trips. It is important to note that auto users travelled significantly longer trips than transit users, pedestrians and cyclists. Auto users tend to reside in areas with much higher median household incomes than pedestrians, cyclists or transit riders.

(Insert Figure 3 around here)

Meanwhile, Figure 4 shows the distance decay curve for auto users to each street. It is clear that trips to Ontario and Monkland are much shorter than to Saint-Laurent and Saint-Hubert. Saint-Laurent and Saint-Hubert have a much higher proportion of trips in the tail-end of the distance decay curve. In contrast, Ontario and Monkland have the majority of trips originating less than 5 kilometers (3.2 miles) away. It would appear that Ontario and Monkland are serving a more local clientele. In addition, this can be explained since Saint-Laurent and Saint-Hubert have a smaller proportion of businesses that mainly serve a local clientele although they have a much higher business density (see table 1).

(Insert Figure 4 around here)

Table 3 shows summary statistics for each mode and for the entire combined dataset. It is clear that auto users travel longer distances to reach these streets. Motorists reside in areas of higher median house hold income compared to the household incomes for pedestrian and cyclists, who are mainly coming from the neighboring area of each street. This suggests that neighborhood characteristics such as median household income have an impact on the mode choice or that a traveler who is travelling longer distances is willing to travel more. Pedestrians and cyclists are also significantly younger, using a t-test, (1.6 years younger than car users on average). Transit users are older on average. What is not surprising is that the diversity index of the segment visited is not very different for all modes. The diversity ranged from 10.3 (15 business categories) to 25.3 (38 out of 150 business categories). Car users undertook more trips in a day than for other modes. This could be because car users are doing more trip chaining. Transit riders travelled much less often than for other modes; this difference was significant using a mean t-test. This suggests that transit users may have less accessibility than other modes.

(Insert Table 3 around here)

Trip Distance Models

To understand which factors influencing users to travel shorter distances a set of linear regression models are generated. A model is generated for three travel modes: car, walk/bike and transit. The models are being separated by mode to enable a better understanding the factors affecting distances for each individual mode. These models are shown in table 4. In addition, the model including all modes is included in table 4 to show the bias that can be added to these models when combining modes.

(Insert table 4 around here)

For car users, the destination has an impact on the trip distance. More diverse street segments tend to attract users from further distances; 140 meters is added to the trip distance for every percent higher of business diversity, when keeping all other variables constant at their mean value. This corroborates with the findings of Arentze (*6*) that found that shopping malls, even though usually less diverse than these commercial streets, attract many users because of the number of different opportunities available. The destination type also tends to have an impact on trips. Trip lengths to boulevard Saint-Laurent and rue Saint-Hubert are longer than trips to Monkland Avenue by 2185 meters and 1930 meters respectively. This is not surprising since Saint-Laurent is characterized by a large number of restaurants, nightclubs, furniture stores and upscale shopping in addition to having a higher density of businesses. The large number of clothing, bridal and other apparel stores on Saint-Hubert are aggregators, which would be categorized as selling "shopping goods" as defined by Holton (*4*), would also cater to a clientele from a larger geographic basin. Trips to Ontario were not very different than those to Monkland probably because both have a proportion of businesses catering to local needs. The number of trips taken in a day is statistically significant. Users that undertake more trips in a day are much more likely to be originating from closer areas, for each trip being made during the day the travel distance is expected to decrease by 274 meters. Accordingly, trip chaining appears to have a substantial effect on decreasing trip distances. Trip purpose does show some kind of policy significance due to the power of the coefficients but none of the variables were significant. Trips made in the evening after 6 PM were much shorter relative to trips made at other times during the day, especially trips started in the morning between 6 AM and noon (1403 meters). This is mainly influenced by the type of opportunities being visited in the evening versus those visited during the day. The type of neighborhood that users live in was also statistically significant; users travelled an additional 36 meters for every thousand dollars of additional median household income in their home census tract.

Different factors influence the trip lengths of pedestrians and cyclists when compared to car users. The destination does not have any impact on trip lengths. The median household income also did not have an impact on trip lengths. This is probably since the majority of pedestrians and cyclists live in the neighborhoods surrounding the street. Trips in the afternoon (noon to 6 PM) were also 200 meters longer than evening trips if keeping all other values to their mean value and might be due to trip chaining. Users that visit these streets to shop travelled statistically significant shorter distances, 547 meters than other non-work related trips. This leads us to believe that the shopping opportunities visited by pedestrians cater to a much more local clientele than other shops. Most of these streets have other competing commercial streets within a relatively short distance (see table 1). In addition, the surrounding neighborhoods also have a number of small shops on other non-commercial streets such as convenience stores. Speculation would be that pedestrians visiting these streets to shop for convenience goods within the neighborhood would visit opportunities closer to their destinations. Furthermore, this is the only mode in which the sex of users was statistically significant; men travel an additional 153 meters than women. Of course, since cyclists were combined with pedestrians, cyclists travelled significantly longer distances.

As for transit riders, it is of note that some personal, neighborhood and trip variables were all statistically significant when explaining trip distances. Contrary to car users, diversity tends to attract transit riding users from shorter distances. This could be explained because transit users have less accessibility than auto users. The only street that had a statistically significant longer distance for transit trips is Saint-Hubert (4,563 meters longer than rue Ontario if keeping all other values to their mean). This street has better transit accessibility being only a few blocks away from two métro (subway) stations, one of them being a major transfer station, even though other streets are all within 600 meters of the closest métro station. All of the streets are well served by bus lines. Age has an impact on the travel distance; older users travel shorter distances. The time of day also had an influence on transit riders' travel distances. We would speculate that this is because some commuters might trip chain and visit the street before heading to work. Income of the home neighborhood had a larger influence on distances than for car users. Users from higher income neighborhoods travel even further (55 meters vs. 36 per thousand dollar median household income increase, if keeping all other values to their mean). The accessibility to transit services, represented by the number of bus stops within 400 meters of home, also had a statistically significant negative impact on trip distances. Users with more bus stops usually have better accessibility to various services and thus travel shorter distances. None of the trip purpose variables were significant although the coefficients had high magnitudes.

When looking at the model combining all modes, we notice that 11 variables are statistically significant in explaining the trip distance. Because all modes are combined, the overall model has a clouding effect on which factors affect specific user types. For example, if only the combined model would be used in the analysis, it would hide that personal characteristics have an influence on transit users, pedestrians and cyclists because the age and sex do not have a significant impact on the travel distance for car users. In addition, the diversity of a street segment is significant for some modes but not in the overall model. On the other hand, this model also clearly shows that the mode has a statistically significant impact on trip distances. Cyclists, pedestrians and transit users travel considerably shorter distances than car users.

CONCLUSION

Many factors influence the length of trips but what could be safely mentioned is that proximity to the street is a large attracting factor. The findings also suggest that these streets, although similar in form, attract different types of users. By separating the analysis of trips by mode, we see that different factors affect the trip distances for each mode. Neighborhood of origin, trip purpose and destination characteristics have a large influence on the length of trips for transit users. This can be contrasted by pedestrians and cyclists for whom personal characteristics had the main impact on the travel distance but, surprisingly, none of the destination variables had an influence on increasing trip distances.

Further research could look into incorporating and comparing the number of opportunities that could also be accessed based on a number of constraints such as work trips, the travelled distance and the probable route taken. It would also be of use to see what characteristics of each street have an effect on the travel distance. This could be done only by increasing the sample size or designing a specialized survey. Also incorporating more streets in the analysis should lead to a more in-depth understanding of the reasons that can lead to a decline in travel distances.

This research shows that when looking at designing similar streets, it is important to note that the function of the street will have a large impact on the types and the lengths of trips attracted, especially motorists. Streets that are more local in character have less business density and attract more trips from closer by. Streets that have a large number of shops that aggregate together such as Saint-Hubert and Saint-Laurent attracts people from further distances. This being said, it is also not possible to further distribute these types of shops because these establishments derive benefits from clustering because customers tend to comparison shop for these goods or services.

Customers using different travel modes are attracted for different reasons. Pedestrians and cyclists seem to be using these streets because of their proximity. For transit riders, attention should be placed on the diversity of the destination and the accessibility of transit. Car users seem to be the most impacted by the attractiveness of the destination, represented by the diversity index, since added distance represents less travel time than for other modes. Although, having successful and diverse streets is desirable, it seems that one of the problems of this success is that car users will be more willing to travel there because of its attractiveness.

REFERENCES

1. Weiler, S. et al. Understanding the retail business potential of inner cities. *Journal of Economic Issues,* Vol., No. 3, 2003, pp. 1075-1105.
2. Cervero, R. and C. Radisch. Travel choices in pedestrian versus automobile oriented neighbourhoods. *Transport Policy*, Vol. 3, No. 3, 1996, pp. 127-141.
3. Agence Métropolitaine de Transport (AMT). *Enquête Origine-Destination de la Région de Montréal*, 2003. [electronic database].
4. Holton, R. The distinction between convenience goods, shopping goods and specialty goods. *The Journal of Marketing*, Vol. 23, No. 1, 1958, pp. 53-56.
5. Carpenter, J. and M. Moore. Consumer demographics, store attributes, and retail format choice in the US grocery market. *International Journal of Retail and Distribution Management*, Vol. 34, No. 6, 2006, pp. 434-452.
6. Arentze, T., H. Oppewal and H. Timmermans. A multipurpose shopping trip model to assess retail agglomeration effects. *Journal of Marketing Research*, Vol. 42, 2005, pp. 109-115.
7. Limanond, T. and D. Niemeier. Effect of land use on decisions of shopping tour generation: A case study of three traditional neighborhoods in WA. *Transportation*, Vol. 31, No. 2, 2004, pp. 153-181.
8. Krizek, K. Neighborhood services, trip purpose, and tour-based travel. *Transportation*, Vol. 30, No. 4, 2003, pp. 387-410.
9. Mokhtarian, P., I. Salomon and L. Redmond. Understanding the demand for travel: It's not purely derived. *Innovation*, Vol. 14, No. 4, 2001, pp. 355-380.
10. Handy, S., and K. Clifton. Local shopping as a strategy for reducing automobile travel. *Transportation*, Vol. 28, 2001, pp. 317-346.
11. Handy, S. Smart growth and the transportation land-use connection: what does research tell us? *International Regional Science Review*, Vol. 28, No. 2, 2005, pp. 146-167.
12. Clifton, K., R. Ewing, J.-M. Knaap, and Y. Song. Quantitative analysis of urban form: a multi-disciplinary review. *Journal of Urbanism: International Research on Placemaking and Urban Sustainability*, Vol. 1, No. 1, 2008, pp. 17-45.
13. Convercité (2003). *Commercial Arterial Studies*, http://www.convercite.org/biblio.php?id=1195616808&lang_id=en. Accessed March 29, 2008.
14. Statistics Canada. Canada Census 2001.

List of Tables

List of Figures

TABLE 1: Comparison of four selected traditional commercial streets

	Street			
Variable	**Monkland**	**Ontario**	**Saint-Laurent**	**Saint-Hubert**
Limits	Grand to Girouard	Darling to Pie-IX	Sherbrooke to Mont-Royal	de Bellechasse to Jean-Talon
Length (km)	1.01	0.98	1.57	1.23
Neighborhood	Notre-Dame-de-Grâce	Hochelaga-Maisonneuve	Plateau-Mont-Royal	Rosemont-la-Petite-Patrie
General orientation	East-West	East-West	North-South	North-South
Number of Businesses (Susceptible to be frequented by non-work users)	122	145	333	273
Top 3 business categories	Eating Places (19), Beauty Shops (7), Real Estate Agents (6)	Eating Places (20), Beauty Shops (8), Misc. Retail Stores (7)	Eating Places (64), Drinking Places (21), Clothing (3 sub-cats. tied at 12)	Women's clothing stores (47), Shoe Stores (21) , Jewelry Stores (19)
Average Yearly Sales per Establishment ($)	709,209	697,210	779,754	437,779
Business Density (#/km)	120.8	148.0	212.1	222.0
Number of Other Commercial Streets within 800m of Street	1	1	8	4
Number of Grocery Stores	4	5	11	1
Percentage of Eating Places (%)	15.6	13.8	19.2	4.8
Percentage of Food Shops (%)	9.8	9.7	6.0	1.5
Percentage of Clothing Shops (%)	6.6	13.1	15.3	42.1
Percentage of Local Shops (%)	25.4	26.2	13.5	11.4
Total trips by Car	62	78	134	85
Total trips by Transit	6	28	60	53
Total trips by Bicycle and walking	33	67	120	48
Total trips	101	173	314	186

TABLE 2: Variables

Variable	Description	Source	Year
Trip/Individual Variables			
Trip Distance (m)	Distance based on the shortest travel time (car) or shortest distance (other modes) accounting for the mode used	OD Survey Road DMTI STM	2003 2008 2007
Sex	Sex of respondent (0 = Male; 1 = Female)	OD Survey	2003
Age	Age of respondent	OD Survey	2003
Trip Start Time	Starting time of trip	OD Survey	2003
Number of Trips	Number of trips that the survey respondent undertook during the same day. For example, a trip chain from home to the store and back would be counted as two trips.	OD Survey	2003
D Home	Dummy variable for trips starting from the respondent's home (1 = home origin, 0 = other origin)	OD Survey	2003
D Shopping	Dummy variable for shopping trips (1 = shopping; 0 = Other reason)	OD Survey	2003
D Entertainment	Dummy variable for entertainment trips (1 = entertainment; 0 = Other reason)	OD Survey	2003
D Other	Dummy variable for other non-work related travel including school, health and (1 = other non-work travel; 0 = Other reason)	OD Survey	2003
D Car User	Dummy variable for car users (1 = car user, 0 = other mode)	OD Survey	2003
D Transit User	Dummy variable for transit users (1 = transit, 0 = other mode)	OD Survey	2003
D Cyclist	Dummy variable for cyclists (1 = cyclist, 0 = other mode)	OD Survey	2003
Street Variables			
D St-Hubert	Dummy variable for the street (1 = street user, 0 = not a street user)	OD Survey	2003
D St-Laurent	Dummy variable for the street (1 = street user, 0 = not a street user)	OD Survey	2003
D Ontario	Dummy variable for the street (1 = street user, 0 = not a street user)	OD Survey	2003
D Monkland	Dummy variable for the street (1 = street user, 0 = not a street user)	OD Survey	2003
Street Segment Variables			
Diversity Index	The diversity index is a representation of the diversity of each street segment by dividing the number of business categories represented on each street segment by the total number of business categories on all street segments (146). Business categories are determined using the NAICS number.	Dun & Bradstreet	2008
Characteristics of Home Area			
Income	Median household income of the respondent's home census tract (2000, $)	Canada Census	2001
N Bus Stops Home	Number of transit stops (bus stop or métro station) within 400 meters of user's home using the walking network	STM Road Network (DMTI)	2007 2006

TABLE 3: Descriptive Statistics

Variable	Mean	Std. Deviation	Minimum	Maximum
All Modes				
Trip Distance (m)	4080.7	4717.9	0.0	24200
Number of Transit Stops within 400m of Home	9.39	5.28	0	26
Age	43.2	16.4	18	87
Number of Trips	4.37	2.32	1	16
Median household income ($, 2000)	37058	18846	14168	213211
Diversity Index	17.26	4.95	10.3	25.3
Car				
Trip Distance (m)	6293.0	5480.7	0.0	24200
Age	43.2	14.7	18	84
Number of Trips	4.67	2.37	1	16
Median household income ($, 2000)	43472	23378	14168	213211
Diversity Index	16.94	5.01	10.3	25.3
Walk and Bike				
Trip Distance (m)	890.8	848.8	10.2	4722
Age	41.6	17.2	18	87
Number of Trips	4.52	2.43	2	16
Median household income ($, 2000)	31100	11300	17377	75738
Diversity Index	17.52	4.90	10.3	25.3
Transit				
Trip Distance (m)	4493.5	3463.0	320.2	18440
Age	45.9	18.3	18	87
Number of Trips	3.39	1.63	1	10
Median household income ($, 2000)	32256	10829	14168	89076
Diversity Index	17.55	4.86	10.3	25.3
Number of Transit Stops within 400m of Home	10.82	4.57	0	21

N = 774

TABLE 4: Trip distance linear regression models

Variable	Car		Walk and Bike		Transit		All Modes	
	B	**t**	**B**	**t**	**B**	**t**	**B**	**t**
(Constant)	2.26	0.01	**1047.42**	**2.84*** **	**5102.22**	**1.73***	**2839.58**	**2.59*****
Sex	-221.43	-0.39	**-153.15**	**-1.69***	-285.59	-0.48	-245.57	-0.84
Age	7.01	0.34	2.35	0.82	**-29.47**	**-1.71***	0.69	0.07
Number of Trips	**-274.51**	**-2.25****	-31.18	-1.63	-200.90	-1.13	**-165.41**	**-2.59*****
Shopping Trip Dummy	436.93	0.59	**-547.51**	**-4.00*****	-374.53	-0.49	-114.72	-0.30
Entertainment Trip Dummy	813.91	1.20	-146.90	-1.02	1125.01	1.47	568.18	1.50
Home Start Dummy	833.36	1.32	-31.79	-0.34	-181.29	-0.29	234.20	0.75
AM Trip Start Time Dummy	**1403.81**	**1.76***	-56.83	-0.42	**1767.27**	**2.08****	**999.82**	**2.38****
PM Trip Start Time Dummy	1177.57	1.62	**202.76**	**1.83***	682.18	0.83	**717.71**	**1.93***
Saint-Laurent Dummy	**2185.84**	**2.31****	30.32	0.17	2262.58	1.47	**1642.05**	**3.12*****
Saint-Hubert Dummy	**1930.09**	**1.66***	288.03	1.35	**4563.05**	**2.80*****	**2135.00**	**3.49*****
Ontario Dummy	1436.74	1.49	118.52	0.59	1575.74	0.96	**1133.27**	**2.08****
Median household income (per $1,000)	**36.38**	**2.82*****	1.04	0.21	**55.47**	**1.91***	**34.31**	**3.94*****
Diversity Index	**140.02**	**1.69***	0.52	0.05	**-164.06**	**-2.29****	33.51	0.86
Number of Transit Stops within 400m of Home	--	--	--	--	**-109.32**	**-1.73***	--	--
D Bike	--	--	**1672.00**	**9.43*****	--	--	**-3789.84**	**-3.97*****
D Pedestrian	--	--	--	--	**--**	**--**	**-5067.80**	**-13.86*****
D Transit	--	--	--	--	**--**	**--**	**-1999.68**	**-4.78*****
R Square	0.100		0.333		0.224		0.315	
N	359		268		147		774	

Dependent Variable: Trip Distance (m)
* 90% significance level | **95% significance level | *** 99% significance level

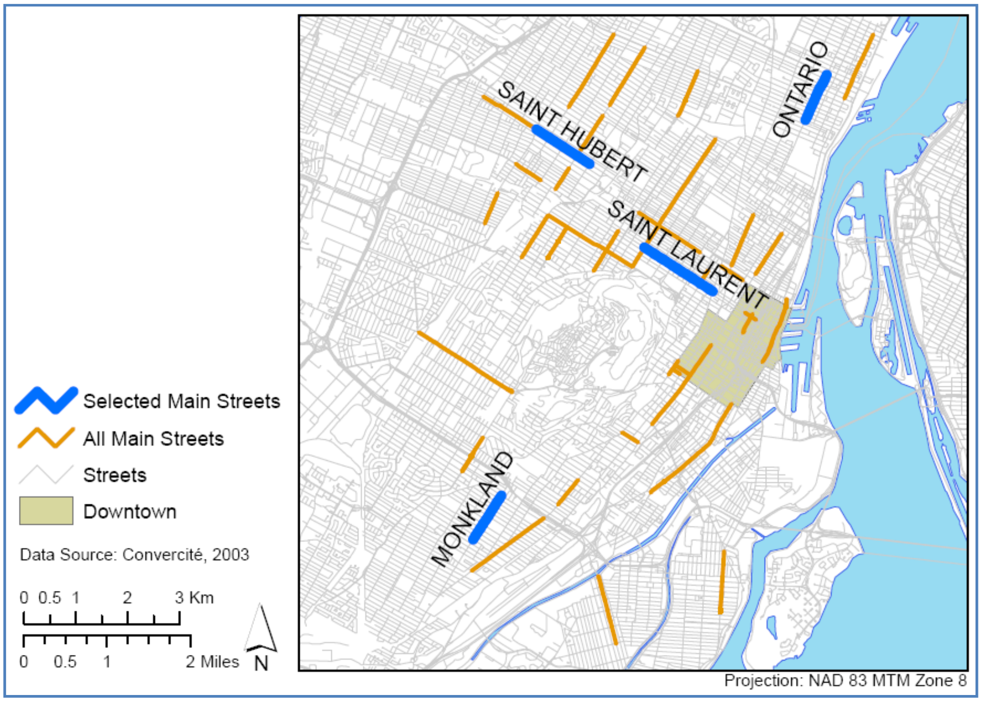

FIGURE 1: Study area

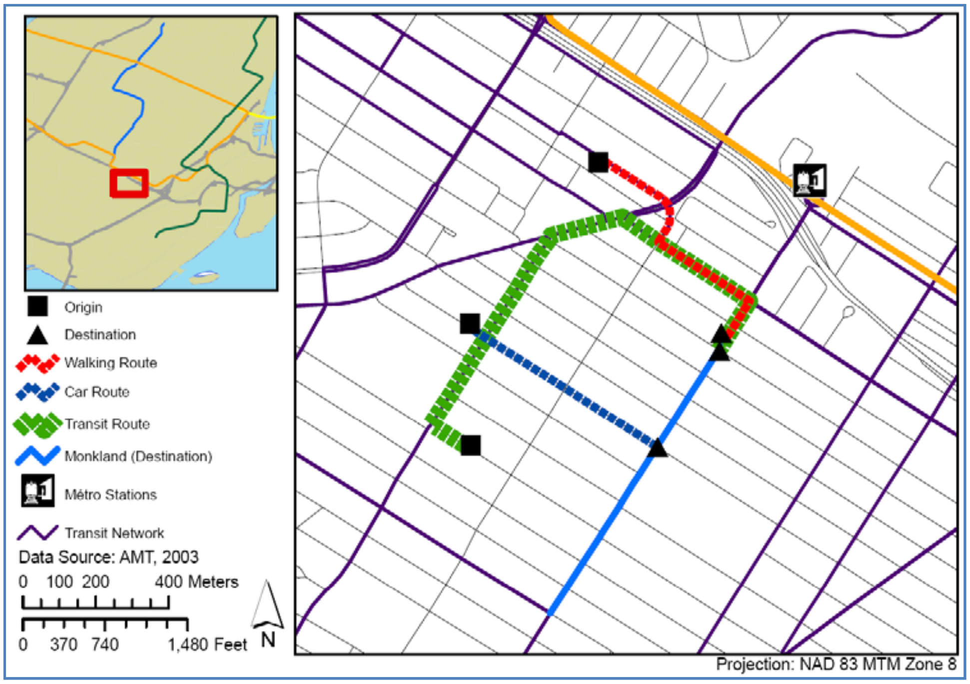

FIGURE 2: Representation of modeled routes using three different modes.

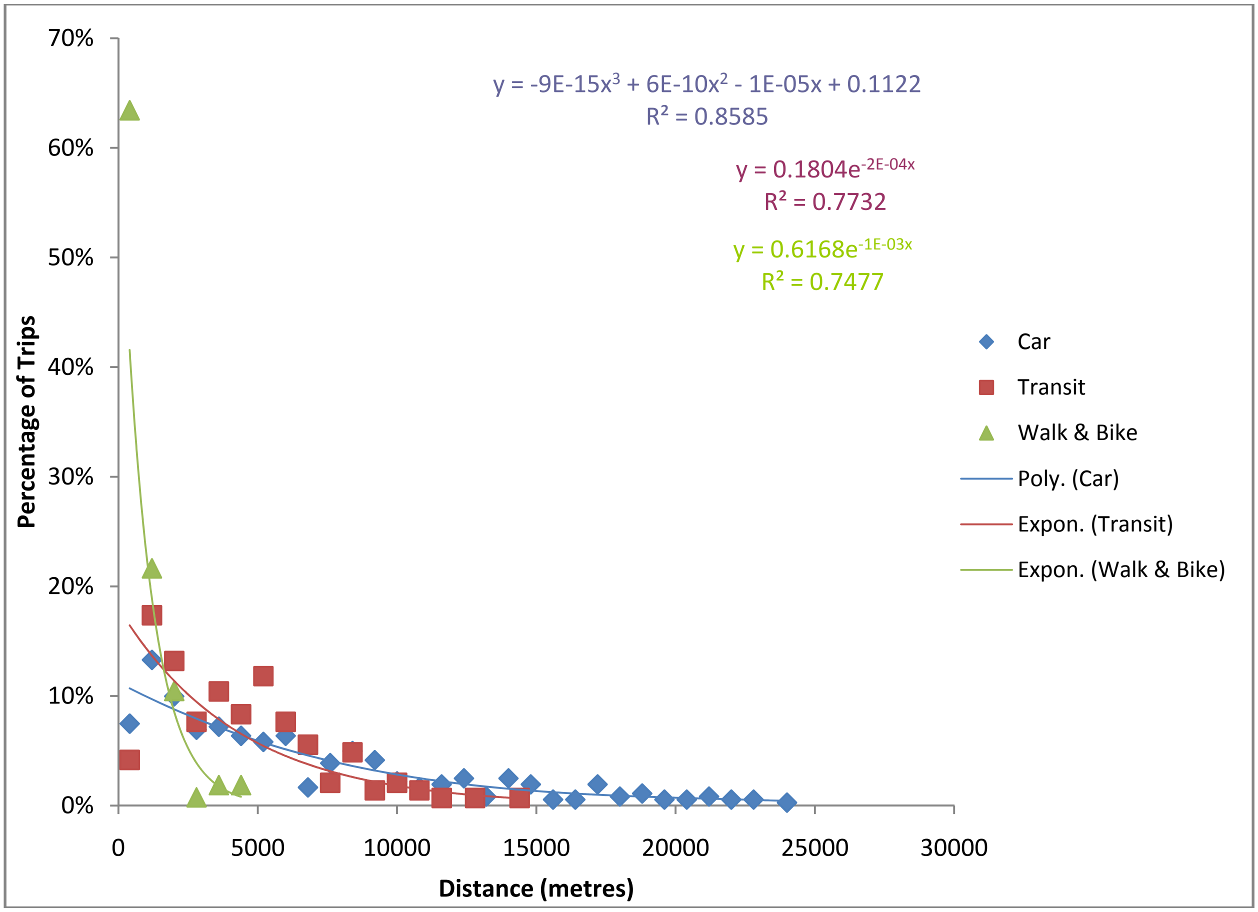

FIGURE 3: Distance decay curves by mode

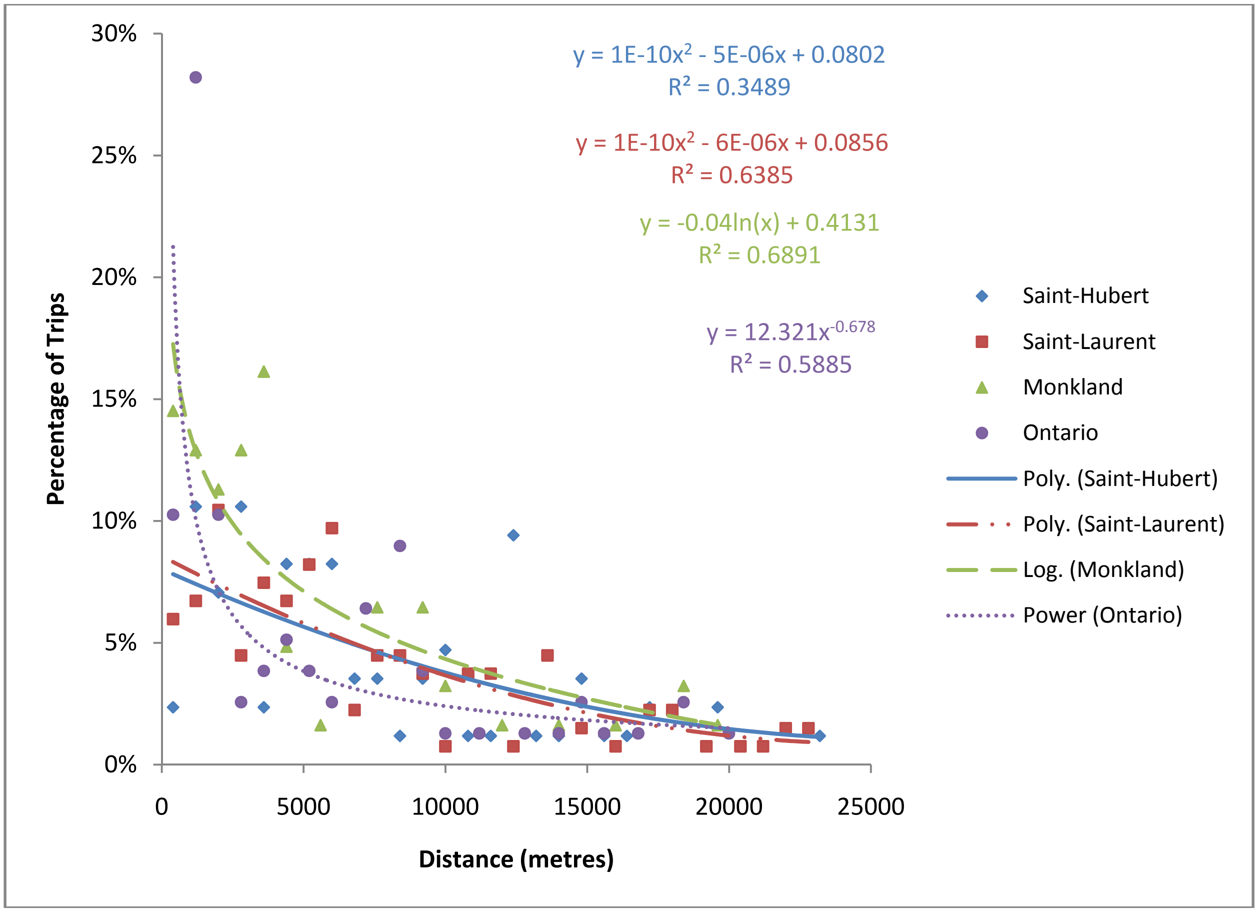

FIGURE 4: Distance decay curves by street