The Impact of the Urban Form on the Spatial Distribution of Commercial Activities in Montréal

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ABSTRACT

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Julie Villain

This thesis investigates Montréal's commercial arteries through a morphological analysis. The purpose of this research is to explore the impact of spatial determinants pertaining to street permeability and street centrality on the nature and spatial distribution of retail activities along a commercial artery.

This study develops a typology of commercial streets combining both commercial and morphological characteristics. A first analysis is performed at the global level, highlighting the existence of a relationship between the urban form and the nature of commercial offer. A similar analysis is then carried out on a finer scale, focusing on internal street segments, and reveals the presence of regularities in the spatial distribution pattern of commercial activities, convenience retail in particular.

This research provides a better understanding of how commercial streets function within our cities by emphasizing the significance of the built environment and the spatial structure to explain local commercial streets' underlying dynamics. Furthermore, the results contrast with recent commercial revitalization strategies that focus on economic (commercial mix), physical (urban design) and social (consumers' habits) considerations to ameliorate the local commercial environment and address urban sustainability issues.

ACKNOWLEDGEMENTS

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LIST OF ACRONYMS

The following list describes the acronyms used to refer to the names of Montréal's boroughs throughout the thesis.

Abbreviation	Meaning
AC	Ahuntsic – Cartierville
CDN-NDG	Côte des Neiges – Notre Dame de Grâce
MHM	Mercier – Hochelaga Maisonneuve
PMR	Le Plateau Mont Royal
RDP	Rivière des Prairies – Pointe aux Trembles
RPP	Rosemont – La Petite Patrie
SO	Le Sud-Ouest
VM	Ville Marie
VMPE	Villeray – Saint Michel – Parc Extension

CHAPTER 1 – INTRODUCTION

RESEARCH CONTEXT – MONTRÉAL AS A CASE STUDY

Montréal has always been renowned for being a major place for traders and merchants. Thanks to its strategic location along the St Lawrence River, the city was the main point of entry to Canada and North America. This location contributed to the development of industrial and manufacturing activities as well as transportation infrastructure, and more particularly rail, connecting Montréal to all major cities in Canada and the United States. Following this economic growth, in the late 19th and early 20th century, Montreal was unquestionably established as the Canada's Metropolis (Linteau, 2000).

In addition to its international renown for commercial dynamism, Montréal experienced, over the same period, considerable urban development and expansion of retail activities on a more local scale. An increasing number of businesses dedicated to convenience retail along local commercial streets emerged within residential areas as a result of the urbanization process along with the development of outer urban areas. According to Germain (2000:6), "inner-city Montréal is very much a 'federation of neighborhoods' where local commercial streets remain the hub and where the daily life is lived in low-used

medium density housing". Since then, Montréal's commercial streets have persisted as a strong fixture in the urban landscape.

In recent years, due to the growing competition of out-of-town and suburban retailing, local commercial arteries have received a great deal of attention from various urban planning movements such as New Urbanism, Smart Growth, Compact City, Transit-Oriented Development, etc... Such recent approaches influence policy-makers and urban planners in their conception of the "post-industrial city", while emphasizing the importance of providing local services and amenities to their residents. As a result, numerous economic redevelopment strategies have been designed and implemented as part of broader environmental initiatives that seek to improve Montréalers' quality of life while building a more sustainable city.

From the 1960's, in Montréal, the municipal policy started to support and promote a more 'localist' vision of urban revitalization for commercial arteries in an attempt to protect small businesses against the development of inner-city shopping malls and other forms of suburban retailing (Germain, 2000). For example, since the 1970's, municipal governments have invested significant amount of money, in particular to support the setting up of local merchant associations known as SIDACs (*Sociétés d'Initiatives et de Développement des Artères Commerciales*); "Although funded under economic development initiatives, these programs clearly recognize the symbiotic relationship of local and residential reinvestment and revitalization" (Germain, 2000:186).

Montréal's 1992 Master City Plan contains a set of initiatives that promote the post-modernist conception of "villages in the city". With regard to zoning regulations in particular, instead of favoring the strict separation of residential and commercial functions, the administration decided to allow again the presence of housing above retail units on residential streets. This policy clearly recognizes that favoring mixed land uses is a key factor for making inner-city neighborhoods more attractive as well as for encouraging pedestrian activity both by day and evening. These approaches to commercial revitalization were reaffirmed in the city's 2004 Master Plan. However, none or very few of these strategies recognize the importance of the built environment and the spatial structure within which commercial streets are integrated to comprehend their underlying dynamics.
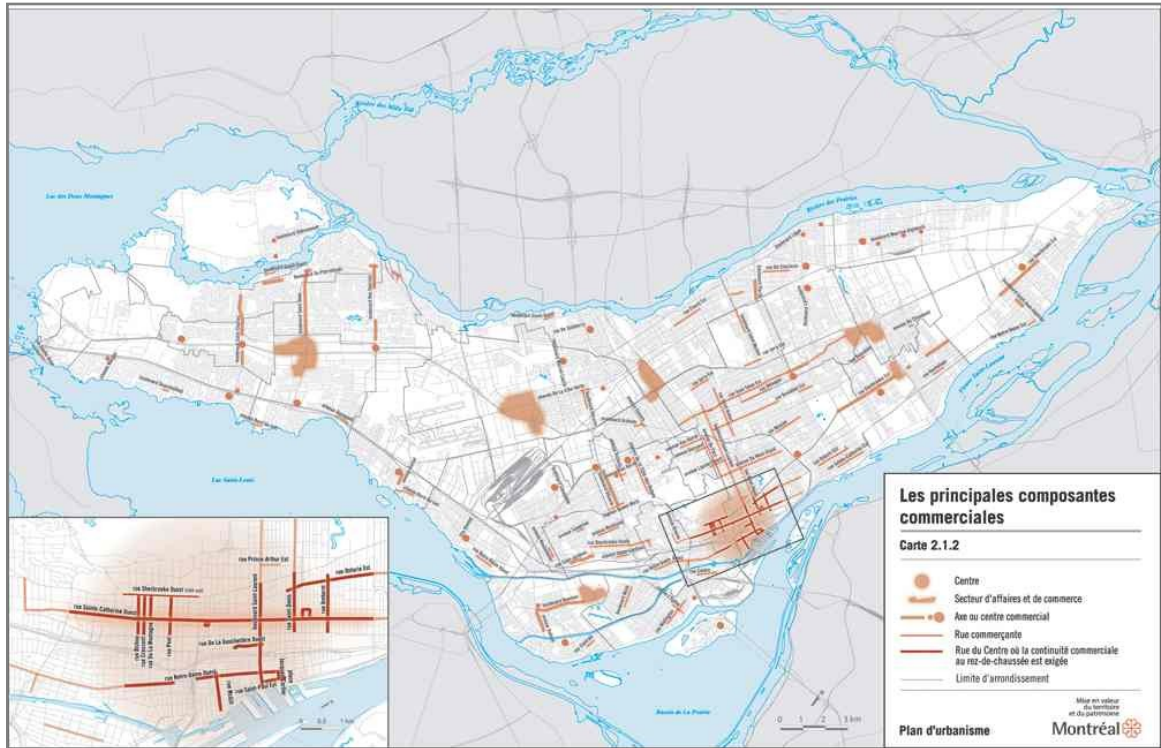
Figure 1. Major Retail Components in Montréal.

Source: City of Montréal, Master Plan 2005.

RESEARCH RATIONALE

By and large, the growing trend towards urban sustainability explains the recent popularity of inner-city revitalization programs. However, these approaches merely focus on physical improvements and urban design issues, such as the renovation of facades, the enlargement of sidewalks, the provision of pedestrian amenities, the planting of trees, among others, in an attempt to make the urban environment more attractive to pedestrians, residents and consumers/shoppers.

There is hence a lack of knowledge of how commercial streets function within our cities, and how the urban form affects the spatial distribution of retail activities along a commercial street. Within the framework of this research, it is argued that the vitality of a commercial street can't be fully understood and explained without exploring its relationships with the physical elements that comprise the urban tissue. Accordingly, this research attempts to fill this gap and draw attention on the significance of the urban form as one key factor underlying the spatial distribution of services and amenities along Montréal's commercial streets.

RESEARCH OBJECTIVES AND HYPOTHESES

As an introduction to this section, definitions of key concepts and notions are provided.

The term "retailing" encompasses both "retail activities" and "commercial services". The first category means the use of land or building for displaying or offering goods for sale to the public and includes, but is not limited to, food and beverage outlets, trade suppliers, yard based suppliers, service stations, secondhand goods outlets, and food courts. The latter category "commercial services" includes all businesses providing general, property, financial, household, private and business services to the general public. It includes, for example, customer banking facilities, real estate agents, hairdressing and beauty salons.

The notion of "commercial offer" refers to the type of good sold, activity performed or service provided. The commercial offer is usually divided into two main categories: "convenience retail" and "specialized retail" – also referred to as "destination retail". The "convenience retail" category refers to daily goods, necessities and services that are usually associated with frequent and short trips; whereas the "specialized retail" category embraces all kinds of goods and services that imply a certain decision-making process and require a specific trip purpose. (More detailed definitions are provided in the methodology section).

Finally, "urban morphology" refers to the discipline that has developed a systemic approach of the built environment through the study of "city forms" (Gauthier and Gilliland, 2006:1) in order to understand the composition and the evolution of the spatial structure. As part of this research, the urban form is examined by looking at the level of permeability and the relative position of the commercial street within a morphological unit, this area being spatially delineated by the presence of physical barriers (thoroughfares, rail tracks/railway, water, etc.…).

The primary objective of this research is to perform a morphological analysis in order to examine the impact of urban form on both the nature and spatial distribution of retail activities along commercial arteries in Montréal. The analysis will be performed at two different scales and the following relationships will be explored.

First, at the global level, i.e. looking at the commercial street in general, the purpose is to explore the relationship between two characters of the urban form,

namely street permeability and street centrality, and the predominant nature of retail offering along the street.

Specifically, commercial streets with higher level of permeability and those that are centrally located within a morphological unit would favor a higher prevalence of convenience retail activities. On the other hand, as comparison and specialty goods and services rely on a wider catchment area, specialized retail oriented streets would be less dependent upon permeability and would also most likely be peripherally located, i.e. along major arteries or at the border of two morphological units.

The second part of the analysis is performed on a finer scale, i.e. looking at the distribution of commercial establishments per street segment. Again, the purpose is to assess the impact of spatial determinants on the spatial distribution of commercial activities by capturing local variations within the street and identifying the presence of different retail profiles according to the segments considered. By performing a finer analysis, the aim is to reveal a certain consistency in the spatial distribution pattern of retail activities along a commercial street. Specifically, an analogous relationship between the permeability level and the category of commercial establishments is explored at the local level; that is to say, concentrations of convenience stores would be located along highly permeable street segments, while low permeable sections would be more amenable to specialized retail.

Finally, this research seeks to investigate the impact of parks, attractors and metro stations on the spatial distribution of convenience stores. Such establishments are suspected to act either as a hindrance or as a generator of convenience retail activities in close proximity.

Increasing knowledge about the impact of the urban form on retail location allows for a better understanding of the underlying dynamics that contribute to the vitality and success of local commercial streets. This knowledge will provide new insights for implementing local commercial areas revitalization strategies, and would be of great practical value for urban planners, policy-makers and "business people" (SDC, merchants' association, developers, retailers, etc…). These findings could also be relevant within the framework of recent urban planning policies that aim at building more local and sustainable communities, but which might suffer the lack of empirical evidence that points to desirable spatial layouts.

CHAPTER 2 – LITERATURE REVIEW

This chapter examines the contemporary issues raised in the literature regarding the spatial pattern of urban retailing. Second, the evolution and reviving significance of traditional commercial arteries, often known as "Main Streets", is traced. Third, a brief summary of different classifications of consumer goods and services developed in the retailing and marketing literature is provided. The fourth section explains and elaborates on the morphogenetic approach of this research, while the last part discusses recent research exploring the link between urban form and shopping travel behavior.

THE EVOLVING PATTERN OF URBAN RETAILING

This section provides an overview of several theoretical models that aim at unveiling a spatial pattern of retail activities by describing the location and the distribution of commercial establishments within the urban structure.

The Hierarchical Model of Urban Retailing

The Central Place Theory was originally developed by Christaller (1933) and Lösch (1940) to describe the retail landscape of Southern Germany. This theory aims to provide a framework for explaining the process of economic agglomeration within cities (Mulligan, 1984).

Central place theory is based on a distinction between "central places" and "peripheries", also referred to as "complementary regions", both together making an entity. Within the framework of this theory, the concept of "centrality" is defined in functional terms, meaning that a place is assessed with regard to its surrounding region and the degree to which it exerts the function of a center. Centers and regions are complementary since the former provides goods and services of different orders while peripheries provide the demand for these goods and services stemming from local residents.

Christaller observed a hierarchical arrangement of central places composed of a great number of central places of lower-order – such as a neighborhood shopping district or a traditional commercial street – usually providing unspecialized goods and services to a local catchment area, alongside a smaller number of central places with greater importance, and only very few places of the highest order that provide highly specialized and high-order goods to extensive areas (Mulligan, 1984; Brown, 1991).

This hierarchical arrangement results in a hexagonal pattern in which each central place is the centre of a hexagonal tributary area and the corner of another. Two additional key concepts lie at the heart of the theory and help to explain the evenness in the spatial distribution of retail activities (Jones and Simmons, 1987). First, the *range* of a good, which corresponds to the farthest distance people are willing to travel to make a purchase, explains, to a certain extent, why lower-order goods and services are more dispersed than higher-order. Then, the *threshold* corresponds to the minimum number of people

necessary to support economic activity and explains why higher-order services, requiring larger threshold, tend to be located in more accessible locations.

As a consequence, the central place theory provides a framework to predict settlement locations based on the function of the settlement structure (levels of goods and services offered), as well as the size of the hinterland served.
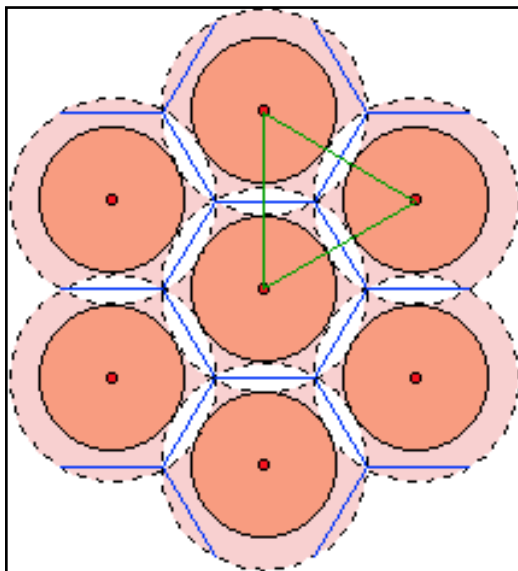
Figure 2. Christaller's Central Place Theory

Arrangement of central places in space relative to a single central good.

Source. http://de.wikipedia.org

Within the framework of this research, this literature is essential to clarify the existing relation between a certain category of commercial offer and the relative position of a commercial settlement within the urban structure. For instance, traditional commercial arteries and "local" Main Streets usually provide low-order and frequently purchased goods and necessities for a local clientele. Therefore, these arteries are generally centrally located, facilitating pedestrian access and movement and fostering neighborhood community life in a small settlement such

as a town. On the other hand, streets that are peripherally located, i.e. at major transportation foci or along two morphological units, are also the most accessible for automobilists. Therefore, based on central place theory, these commercial arteries would provide goods and services of higher order to a wider catchment area. This relationship between retail location and retail activity highlighted by central place theory served as one basis for building the conceptual framework of this research. In fact, the morphological analysis presented here seeks to explore whether such a relationship still holds at a local scale, i.e. when examining the spatial distribution pattern of retail activities along Montréal's commercial arteries. To conclude, the traditional model described by the central place theory supposes a clear hierarchy of commercial settlements, built upon a combination of the types of goods and services provided and their relative position within the urban structure. Although this theory still holds at larger scales, essentially global and national, (Borchert, 1998; Brown, 1994), this established hierarchy has been called into question and some of the basic assumptions were challenged (Brown, 1994).

Typology of retail configurations

From the 1960's, the validity of the hierarchical model was contested mainly because of the emergence of new retail structures that undermined both the traditional framework (Davies, 1984) and the traditional patterns of accessibility to retail activities and services (Handy, 1993). For example, Dawson and Kirby

(1980:89) stated that "hierarchical models are no longer adequate representations of urban retail provision, nor are they an adequate basis for planning retail land uses over the next twenty years".

The retail environment was strongly shaped by the evolution of consumers' demand and the loosening of geographical constraints stemming from the increased mobility of customers offered by their private cars. From the 1950's, the residential suburbanization process was further accompanied by retailers' decision to locate in less congested suburban areas, which were also more accessible to their customers (Handy, 1993): "These new centers drew business from both the Central Business District and local commercial areas, since they offered a mix of comparison and convenience shopping and the possibility of one-stop shopping" (Handy, 1993:16). This gave rise to a variety of modifications in the spatial arrangement of retail structures and the development of "quasi- and post –hierarchical retailing typologies" (Brown, 1994: 372) (see, for example, Potter, 1982; Dawson, 1983; Jones and Simmons, 1987).

Berry's typology (Berry, 1963)

In 1963, Berry proposed a new classification of retail configurations in order to give a more realistic picture of the urban commercial structure that resulted from technological and transportation evolutions. Berry's typology preserves the spatial emphasis previously given by the hierarchical model (Fairbain, 1984) and identifies three different types of retail configurations

- **Nucleations** correspond to a mixture of planned and unplanned shopping areas, occurring at various transportation foci. Berry identified five different types of retail nucleations: CBD, regional shopping centre, community centre, neighborhood centre, convenience or isolated store cluster.

- **Ribbons of commercial activity** are retail structures located along arterial routeways. These are easily accessible, automobile-oriented and usually not associated with a specific category of commercial offer.

- **Specialized shopping areas** are retail configurations devoted to a specific category of merchandise and are mostly located at focal points of the transportation network. Repair shops, furniture and allied stores, large and independent discount store or medical centers are examples of specialized shopping areas.

As mentioned, Berry's classification conserves the spatial dimension that was underlined in the hierarchical model as it still allows for the prediction of the type of retail activity found at a specific location based on the relative position within the metropolitan area. Also, his classification attempts to depict the new commercial structure that was shaped by consumers' increased use of automobiles. However, more recent evolutions have blurred these established boundaries, making the attempt to embrace the overall pattern of urban retailing more and more difficult.

Post-Hierarchical Classifications

Known as the "Golden Age" of locational analysis (Brown, 1994), the 1980's were characterized by the emergence of new retail classifications in the attempt to respond to the "Post-Hierarchical Challenge" (Brown, 1994). These new typologies no longer gave much attention to the link between the commercial offer and the physical location of a commercial settlement. In contrast, they sought to embrace the growing complexity of consumers' shopping behavior alongside the increasing number of shopping retail formats. As one example, Dawson and Sparks (1987) provided a five category classification that aims to match consumers' needs and requirements with the type of stores they usually seek for. In this classification, contrary to place-based theories, no consideration was given to the spatial location of the commercial establishment.

Consumer Need	Retail Response
Essential Shopping	- Local convenience shops (convenience) - Corporate mass merchandisers (price, utility)
Fun/Leisure Shopping	- Specialist shopping areas (product range, style…) - Large leisure/Shopping complexes (leisure activity, style) - Fashion/lifestyle retailing in planned cluster (multipurpose activity)
Purposive Shopping	- Large, Target Shopper Units (product range) - Wide range of variety stores (value)
Time-pressured Shopping	- Home Shopping (time) - Petrol Station Shops / Convenience stores (time)
Innovative Shopping	- Home based facilities (Access) - Catalogue Showrooms (Range)

Table 1. "A post-Hierarchical classification of shopping/retailing activities"

Source: Dawson and Sparks (1987)

Following this theoretical shift, Brown (1991) proposed his own "post hierarchical" taxonomy of urban retail locations. By combining the form – or shape – of a shopping area with the types of retailing function, Brown reasserts the locational dimension that was emphasized in both the hierarchical model and Berry's classification. He identifies three different forms of shopping areas:

- *Clusters* correspond to "compact agglomeration of retail outlets". These may be either planned or unplanned;

- *Linear* shopping areas are assemblage of retailing facilities that extend along major, and even minor, roads;

- *Isolated* forms of retail are single, often freestanding, outlets separated from other commercial establishments.

Then, Brown (1991) distinguishes three functions of shopping:

- *General* shopping, which embraces a wide variety of retailing outlets catering for the multi-purpose shopping behaviors of consumers;

- *Specialist* shopping areas are those with a large number of shopping outlets selling similar products; and

- *Ancillary* locations are not primarily shopping areas but consist of retail establishments capitalizing upon pedestrian traffic generated by non-retail activities such as hotel lobbies, airport departure lounge….

Forms and Functions can then be combined, as shown in table 2 (Brown, 1991: 374):

FUNCTION / FORM	GENERAL	SPECIALIST	ANCILLARY
CLUSTER (unplanned)	Town and city centers	Bright Lights District	Sandwich Bars in Financial District
CLUSTER (planned)	Mega-center	Specialty Shopping Center	Shops in Airport Departure Lounge
LINEAR	Traditional Arterial Route	Ethnic Shopping Street	Hamburger Alley
ISOLATED	Corner Shop	Carpet Warehouse	Crush Bar in Opera House

Table 2. "A non-hierarchical classification of retail locations".

Source: Brown (1991)

This set classifications aim to provide a new conceptual framework to analyze retailers' locational decisions. Within the context of this research, it is necessary to emphasize the challenges experienced by local commercial streets in

competing with new retail forms as these new formats, by being more accessible, are deemed to be more convenient to suburbanites, and to cater more to their shopping needs, requirements, and expectations.

In sum, the spatial distribution of the retail system within the metropolis has evolved alongside forces of changes from both the demand and the supply side. Downtown areas and local commercial arteries have faced increased competition from the periphery (Jones and Simmons, 1987) and have experienced dramatic changes with regard to the basic functions they used to perform within their designated community (Handy, 1993; Birkin et al., 2002). These transformations were accompanied by new public policies of urban revitalization that led to the emergence of a new retail structure within the city.

THE CHANGING MAIN STREET

This section portrays the recent transformations endured by the traditional Main Street, and by extension local commercial arteries. These urban settlements have recently received attention as a part of both sustainable and economic revitalization policies. In fact, various strategies have been implemented to counter the decline of local commercial districts and to revitalize urban neighborhoods by luring people and business back to inner-cities.

Decline and Resurgence of the Main Street

Spatial, Economic and Social changes

Up until the 1950's, the traditional downtown core was the uncontested commercial "hub" of the city. However, owing to the "unabated spread of suburban and regional shopping malls" (Kalman, 1985), Main Streets and more traditional commercial arteries faced major challenges in maintaining their attractiveness and economic vibrancy. The loss of residents and office workers deprived storekeepers located on Main Streets from a captive market (Kalman, 1985). Changes affecting traditional commercial arteries included a shift in retail offerings and a decline in the social significance of Main Streets.

Specifically, the nature of retail along the Main Street has evolved towards greater specialization. Starting in the 1960's, stores such as clothing, footwear, jewellery, food and fresh vegetables that used to be predominant in the retail landscape have gradually disappeared in favor of a range of niche outlets such as music shops, travel agencies, bars and cafés, etc. (Birkin et al., 2002). As a consequence, many North American downtowns have adjusted from a general to an increasingly specialized retail orientation (Davies, 1984; Fairbain, 1984). In addition, traditional Main Streets have experienced the entry of new services, such as financial, leisure, medical and government services alongside typical retail products (Dawson, 1988).

Furthermore, the social significance of the Main Street has changed (Dawson, 1988). More than a place to shop, the Main Street was also a place for people to

be entertained (Roberston, 1997), contributing to community life and a sense of belonging among residents. While competing with shopping centers and suburban shopping malls, the Main Street conserves a traditional advantage over its "rivals" as it represents the "glory of the past, the symbol of stability, the visual reminder of another time that gives every small town a sense of continuity" (Berton, 1985:2). Furthermore, historic buildings and existing infrastructures combined with a mix of activities and people present within downtown areas give a unique opportunity to its residents to build a "sense of place" (Faulk, 2006), which strongly contrasts with the "nowhere syndrome" (Kunstler, 1993) that prevails in commercial establishments locating on outlying areas and featuring a similar anonymity. Movements in urban planning that encourage Main Street revitalization seek to restore and enhance this unique character of the Main Street. They developed historic preservation and conservation strategies as a key approach to enhance the attractiveness of the Main Street for both social and economic activities.

Finally, Main Street also changed with respect to consumer demand and retail supply. The hierarchical model was challenged because its assumptions regarding the nature of both the demand and the supply were no longer considered as consistent with the reality of the emerging urban pattern of retailing. With regard to supply side changes, the concentration of the market power allowed important economies of scales, which altered the cost of structure retailing (Dawson, 1988; Birkin et al., 2002). In addition to the development of shopping centers and suburban shopping malls, the retail landscape was

transformed by the growth of new retail structures referred to as "power retail developments" (Hernandez & Simmons, 2006). The emergence of these new types of commercial clusters has challenged both planning policies and the existing hierarchy of place. The attractiveness of these "Big Box Stores" – also known as "destination" or "category killer" – relies on the combination of lower prices and wider selection of goods provided to customers. Secondly, numerous changes have been observed regarding consumers' behavior, preferences and choices. First to be mentioned is their increased mobility (Birkin et al., 2002; Fairbain, 1984; Dawson, 1988; Holly & Wheeler, 1972). From the 1950's, private cars became more affordable, which offered consumers greater freedom of choice as to where to live, work and shop (Fairbain, 1984). The ownership of a private mode of transportation has rendered peripheral sites more accessible compared to downtown areas which, in contrast, were unable to accommodate the increasing number of cars in terms of parking and traffic congestion (Sternlieb, 1963). Indeed, as automobile usage intensified exponentially, gridlocks, lack of parking and collisions between cars and pedestrians became the most serious and widespread problems Main Street had to face (Esperdy, 2008). Therefore, local commercial areas had difficulties competing with suburban shopping malls, which "cater directly to the desires of suburbanites for speed and convenience" (Robertson, 1997:3).

The evolution of consumers' lifestyle towards more "sophistication" also explains the increasing demand for a wider range of products as well as a better overall shopping environment in terms of ambiance and individuality (Gransby, 1988).

As a consequence, shopping areas tended to become a lot more leisure-oriented than they used to be so as to offer a "shopping experience" that goes beyond the strict economic transaction. The new urban pattern of retailing comprises a multiplicity of retail structures that coexist within the urban landscape, each of them attempting to cater to the individual needs of consumers.

Main Streets, local commercial arteries as well as downtown commercial areas have strongly suffered from this competitive environment. Therefore, "efforts to revitalize downtown have gained momentum over the past decades" (Faulk, 2006:1) and many local commercial streets are nowadays subject to various redevelopment and revitalization projects.

Revitalizing Main Street

At present, there is a strong consensus among city planners and policy-makers about the significance of downtown cores, inner-city areas and local commercial districts to address sustainability issues in cities (Borchert, J.G, 1998). This explains, to a certain extent, the growing trend in favor of town centre management that was observed over the past few years (Gransby, 1988; Birkin et al., 2002).

Commercial Revitalization Strategies

The attempt to recreate a vibrant economic and social environment in inner-cities to attract merchants and residents is part of both economic and environmental initiatives. First, the underlying belief motivating these strategies is that providing

local shopping opportunities within walking distance on a renewed Main Street will contribute to enhance residents' quality of life by offering them the option to walk to local stores, reducing their need for automobile travel. Many strategies have been developed in North American downtowns in order to foster such a change. Seven downtown revitalization strategies were identified and assessed by Robertson (1995): (1) pedestrianization, (2) indoor shopping centers, (3) historic preservation, (4) waterfront development, (5) office development, (6) special activity generators, and (7) transportation enhancements. Housing development is also considered as an additional strategy. Furthermore, programs were also developed at the national, provincial and municipal levels. Briefly, these approaches are dedicated to revitalizing downtown areas through both physical and economic improvements, as described below.

Main Street, USA.

The *Main Street* program, created and administered by the American National Trust for Historic Preservation in 1980, tackles the economic, social and urban issues faced by Main Streets in American downtowns. Built upon a four-point approach, the program aims to restore the traditional downtowns and to revitalize neighborhood businesses districts. The objective is to increase the attractiveness of the Main Street as both a social and an economic location while preserving its historic context (Hechesky, 2005).

Fondation Rues Principales, Québec, Canada

In the province of Québec, the *Fondation Rues Principales initiated* a similar program in 1985. The mission of the foundation is "to promote sustainable

development based not only on the cultural, natural and socio-economic assets specific to each neighborhood, each town, each village, but also on everything that makes it unique"[1]. The revitalization strategy is mostly based on heritage conservation and preservation. It also calls for the involvement of municipalities and local stakeholders. Thirdly, the program seeks to foster community life through the improvement of public spaces and the urban environment in general.

Montréal

From the 1960's in Montréal, commercial corridors and traditional commercial streets were given a great deal of attention by the municipality. Under the Drapeau administration, commercial revitalization policy was consistent with a "localist-oriented" vision of urban redevelopment (Germain, 2000). Assistance was also provided through merchants' associations. The first four SIDACs (*Sociétés d'Initatives et de Développement des Artères Commerciales*) were created in 1981 for Masson, Monk, Ontario and Saint Hubert streets. Financially supported by the City of Montréal, these associations sought to protect small businesses against the development of inner-city shopping centers. The 1992 Master City Plan pursues its local orientation by proposing commercial revitalization initiatives based on the concept of "villages in the city" (City of Montréal, 1992). Another major step was taken when the administration decided to put an end to the old tradition of separating residential and commercial functions along a street, meaning that housing was now allowed above retail

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[1] Fondations Rues Principales, Quebec, « Role and Mission ».

http://www.fondationruesprincipales.qc.ca/en/foundation/

units along commercial streets (Germain, 2000). In 1998, SIDACs were replaced by the SDCs (*Sociétés de Développement Commercial*), of which there are now fourteen in Montréal. The ASDCM (*Association des Sociétés de Développement Commercial de Montréal*) was created in 2005 and is also involved in the development and implementation of economic revitalization strategies at the neighborhood level. Further revitalization programs have recently been implemented as part of the 2004 Master Plan. For instance, the program "Réussir à Montreal - Pr@m" was launched in 2009 in the attempt to enhance the quality of life of certain districts while supporting the economic growth of 28 commercial streets (Lewis, 2009).

These commercial revitalization strategies are a key measure often put forward by recent popular movements in urban planning (New Urbanism, Smart Growth, TOD etc…). Their proponents advocate for higher densities, both commercial and residential, and higher levels of land use diversity, assuming that providing local commercial opportunities within walking distance to residential areas can reduce the need for automobile travel, provide support to local businesses, and foster neighborhood life.

However, most of these strategies place priority on economic (commercial mix) or physical considerations, while downplaying the impact of local spatial dynamics on the vitality of a commercial street. The commercial offer of a street is usually assumed to be consistent with the market prerogatives and little, if any, consideration is given to the urban environment. Yet, spatial determinants may

also account for the spatial distribution of retail activities along a street, and, on a larger scale, within an urban area. As such, the commercial and inner-city revitalization strategies of these popular planning movements generally lack an in depth analysis of the urban structure that characterizes the commercial street and its vicinity. There is a lack of knowledge on how local commercial streets function within our cities, and about the impact of the urban form on the spatial distribution of retail activities. This research will attempt to fill this gap by exploring the influence of spatial characteristics on local dynamics along commercial streets in Montréal. This knowledge would be of great practical value for ensuring the success of future revitalization projects.

CLASSIFICATION OF CONSUMER GOODS AND RETAIL OUTLETS

This section seeks to probe and review the various classifications of retail goods and retail outlets that were developed in the retailing and marketing literature. As part of this research, a commercial offer typology was built upon a combination of these classifications.

Classification of Retail Goods

The first major classification of retail goods was developed in 1923 by Copeland. Based on the consumer's buying behavior, Copeland identified three main categories of consumer goods: convenience, shopping and specialty goods. This

initial classification has then served as the reference for further typologies of consumer goods (Greenberg and Bellenger, 1974).

In 1948, the American Marketing Association (AMA) adopted a new set of definitions of consumer goods while preserving the essence of Copeland's scheme:

- First, **convenience goods** were defined as "those consumers' goods which the consumer usually purchases frequently, immediately, and with a minimum of effort (AMA, 1948:6);

- Second, **shopping goods** were defined as "those consumers' goods which the customer, in the process of selection and purchase, characteristically compares on such bases as suitability, quality, price and style" (AMA, 1948:15);

- Finally, **specialty goods** were "those consumers' goods on which a significant group of buyers characteristically insists and for which they are willing to make a special purchasing effort (AMA, 1948:15)".

Ten years later, Holton (1958) pointed out some deficiencies regarding these definitions such as the "lack of clear cut distinctions among these three groups" (Holton, 1958:2). He also underlined the simplicity of such categorizations since a given good may be considered as a convenience good for some consumers and as a specialty good for others based upon an income difference. Also, for a given consumer, the same good may also be a convenient good at one time and a specialty good at another moment. Therefore, Holton developed his own

scheme within which the distinction between convenience and shopping goods is based on the probable gain from making price and quality comparisons compared to the cost of the effort expended in the search and purchase process (Bucklin, 1963; Greenberg and Bellenger, 1974).

Following these modifications, Holton's definitions of consumer goods are as follows (from Bucklin, 1963:3):

- **Convenience Goods**: "Those goods for which the consumer regards the probable gain from making price and quality comparisons as small compared to the cost of making such comparisons".

- **Shopping Goods**: "Those goods for which the consumer regards the probable gain from making price and quality comparisons as large relative to the cost of making such comparisons".

- **Specialty Goods**: "Those convenience or shopping goods which have such a limited market as to require the consumer to make a special effort to purchase them".

The next major treatment regarding the classification of retail goods to be considered came from P. Bucklin (1963). Influenced by Copeland's idea regarding the consumer's buying behavior and the extent of his knowledge before making a purchase, Bucklin established two broad categories: "shopping goods" and "non shopping goods". The former group corresponds to Copeland's category of "shopping goods" while the latter encompasses both convenience and specialty goods.

Although updated classifications of retail goods have recently been developed, these three key classes – convenience, shopping and specialty goods – have remained widely accepted. For instance, the *Fondation Rues Principales* has established a classification of the commercial offer based upon these three categories that includes both goods and services:

- *Achats Courants* (Convenience category): Groceries, fresh food shops, news agents, postal services, local credit unions…

- *Achats Semi-Courants* (Shopping category): Clothing store, shoes stores, bookstores, beauty salons…

- *Achats réfléchis* (Specialty category): Computer and electronic products, household appliances…

- *Restauration and Divertissements* (Food and Accommodation Services)

- *Services Publics* (Public Services)

Finally, it should be mentioned that shopping and specialty goods are often grouped together under the broader category of "comparison goods". Indeed, the purchase of such goods requires a process of selection based on "suitability, quality, price and style" (AMA, 1948). Consumers will thus accept to "expand the time and the energy necessary to get the best product at the best price" (Fairchild Dictionary of Retailing, 2009).

This traditional classification of consumer goods has served as the framework for building new classifications of retail outlets and retail areas (Guy, 1998).

Classification of Retail Outlets and / or Retail Areas

Based on central place theory, retail areas have traditionally been divided into two main categories referred to as "unplanned" and "planned" retail areas (Berry, 1963). However, retail development practices and consumers' habits have evolved, making this traditional distinction antiquated for describing the current retail structure.

Based on the previous definitions of consumer goods, retail outlets could simply be classified according to the types of goods being sold. However, this basic classification of retail outlets causes problem when shops sell a variety of goods that have little in common (Guy, 1998). As a consequence, Guy (1998) contends that an accurate classification of retail outlets should be based upon a combination of the types of goods and services provided and shopping trip purposes.

Therefore, a second method of classification of retail areas was built, extending the traditional distinction between convenience and comparison goods to shops. Specifically, a "convenience outlet" is associated with short distances and frequent trips. It usually benefits from a convenient location and is easily accessible. Also, convenience stores attract customers from a local catchment area and provide a limited line of daily goods and necessities, generally at higher prices (Guy, 1998; Fairchild Dictionary of Retailing, 2009). Grocery stores, but also fresh food shops, newsagent, tobacconists, post offices are classed as convenience outlets. In contrast, the "comparison outlet" is usually associated

with a specific destination and attracts occasional shopping trips. These outlets'

attractiveness is based on the extensive range of goods provided, but also on the

level of service offered to the customer as well as the quality of the items sold.

The traditional department store, as well as clothing stores, personal

accessories, bookstores, stationary stores… fall into this category.

This set of classifications provides a framework for investigating the census of

commercial establishments used for the purpose of the study. The present

definitions allow for classifying retail activities into two main categories:

convenience retail, including all convenience stores providing both goods and

services, and specialized retail, including all comparison outlets providing both

shopping and specialty goods and services. This distinction served as the

framework for categorizing and differentiating commercial streets according to

their dominant "retail profile".

MORPHOLOGICAL ANALYSIS

The Study of the Urban Form

The discipline of urban morphology is broadly defined as a systematic approach

to the built environment. Malfroy (1995) explains the emergence of the field by

referring to two distinct but dialectically connected stories: the first is the history

of the city, while the second is the history of ideas about the city. Urban

morphologists themselves have defined their own discipline in simple terms as

the "study of urban form" (Moudon, 1995:3), the "study of city forms" (Gauthier and Gilliland, 2006:1), or again the "study of the city as human habitat" (Moudon, 1997:1). At the heart of the discipline lies the belief that "the city can be read and analyzed via the medium of its physical form" (Moudon, 1997:5).

Urban Form as a dynamic entity

Within the framework of morphological analyses, urban form is regarded as a dynamic and continuously changing entity. According to Moudon (1995), the morphogenetic approach aims to "stress the evolutionary nature of the physical city" (Moudon, 1995:3). Urban morphologists exclude randomness from the morphological process as they seek to identify rules or laws of transformation. A particular logic is thus assumed to dictate the organization of the urban fabric at different periods (Levy, 1999). Also, there is a consensus among researchers to consider the city as an historical process and to recognize the presence of phases of creation and transformation in the evolution of the urban form (Pinho & Oliveira, 2009).

Besides the historical dimension, the morphogenesis approach seeks to grasp the social and economic aspects of the urban form (Moudon, 1995). As a dynamic process, the urban fabric results from a dialectic between the built environment and the social needs of a particular society: "Urban morphologists focus on the tangible results of social and economic forces: they study the outcomes of ideas and intentions as they take shape on the ground and mould our cities" (Moudon, 1997: 3). Hillier and Hanson have developed this social

dimension when they proposed a new theory to emphasize the social dimensions of spatial patterns, and the spatial dimension of social patterns (Pinho & Oliveira, 2009).

Urban Form as a spatial system

The urban morphology approach is also characterized by the idea that the built environment can be understood as a "spatial system". This implies that an analysis of the urban form examines the configuration of spatial objects that comprise the urban tissue at different scales. The morphological elements are referred to as "organisms" (Moudon, 1997), which are arranged in a tight and dynamic relationship, forming the urban tissue (Malfroy, 1995) or the "spatial configuration" (Hillier, 1996).

Theoretical Framework of Morphological Analysis

Theoretical Basis

Moudon (1997) contends that every morphological analysis is based on three basic principles:

1. Three fundamental physical elements compose the urban form: buildings, plots/lots (and their related open spaces), and streets;

2. A morphological analysis can be performed at different levels of resolution, namely the building/lot, the street/block, the city and the region;

3. A morphological analysis must consider the historical dimension of the urban form since the spatial elements undergo continuous evolution and transformation.

Therefore, "form, resolution and time constitute the 3 fundamental components of urban morphological research" (Moudon, 1997:5).

Specifically this research investigates the street – commercial streets in particular – at two different scales of analysis: At the global level, investigating the retail structure within the city, and at the local level, focusing on the spatial distribution of services and amenities within the commercial street. Finally, examining the variety of spatial environments that characterize Montréal's commercial streets reflects historical evolutions of the urban pattern of retailing that was shaped by the emergence of new retail structures alongside the presence of traditional and long-established commercial settlements, namely the local Main Street.

Theoretical Objectives

In general, studies about the urban form are distinguished according to their theoretical objectives and approaches. A key distinction has been established between cognitive and normative approaches. *Cognitive contributions* aim at providing explanations and/or developing explanatory frameworks for understanding urban form (Gauthier and Gilliland, 2006). In contrast, "*normative contributions* aim at determining the modalities according to which the city should be planned or built in the future" (Gauthier and Gilliland, 2006:2). Although the benefit of this distinction may be problematic when looking at studies that could

be consistent with both approaches, it may also be seen as critical for "clarifying the "multi-faceted nature of the intellectual agenda of urban morphology" (Gauthier and Gilliland, 2006:2).

The three schools of urban morphology

Specifically, two main schools dominated the analysis of urban morphology in the 20th century. More recently, the space syntax theory has emerged as an innovative method for exploring spatial configurations. These three schools are briefly described as follows.

The Conzenian and Muratorian traditions

The Conzenian perspective is known as the British historical and geographical school and has its roots in German geography. Conzen focused his research on the plan unit, which is defined by the street, the plot and the building, together forming one area. This town plan has been gradually shaped through the process of urban evolution. Whitehand pursued Conzen's work at the University of Birmingham. He integrated an economic dimension to the analysis of building processes as he emphasized the relationships between the city, its inhabitants and the building industry (Pinho et Oliveira, 2009).

The Italian school of urban morphology was founded in the 1950's by Muratori who developed a typo-morphological approach of the city form. The Italian school was particularly influenced by seminal works in philosophy of history and architecture; Muratori sought to "build a critical theoretical framework to explain

the process of creation and transformation of urban forms throughout centuries"

(Pinho et Oliveira, 2009: 104). His work consisted in a comparison analysis of

internal structure and architectural characteristics of selected urban quarters

between centuries. After the death of Muratori, Caniggia followed the Italian

tradition but simplified Muratori's theory by focusing on a typological analysis of

the city, and abandoned the architectural prevalence of Muratori's perspective.

The Space Syntax Theory

Developed by Hillier and Hanson in the 1980's, the space syntax theory

investigates the city and its spatial configuration using a more mathematical and

quantitative approach. Defined as a "science of power relations" (Sima and

Zhang, 2009:103-1), the space syntax theory gives a new scientific credit to

recent applied morphological studies and aspires to describe a spatial order.

The focus on space, and the relationships between space and movements,

characterize this new theory of spatial analysis (Pinho et Oliveira, 2009). The

concept of "spatial configuration" lies at the heart of the space syntax approach,

suggesting that the configuration of the urban layout itself is the key generator of

movement patterns. Space syntax proponents contend that movement has a

morphological dimension. Another specific attribute of the space syntax theory is

the use of derived, or axial maps, to represent relationships and movements

between a building and an urban area.

Furthermore, the social dimension of space is also examined since the space syntax theory establishes "a descriptive theory of how spatial pattern can, and does in itself, carry social information and content" (Sima et Zhang, 2009:103-6). Finally, this approach is particularly significant in recent morphological analysis as it allows for extracting a variety of topological measures and for the quantification of spatial patterns, often via Geographic Information System (GIS).

Morphological Analysis of Commercial Streets

This research focuses on one of the three physical elements that compose the urban form, the street, and more particularly on the spatial configuration of commercial arteries in the Montréal's urban landscape.

This section probes street typologies and road classifications that were previously developed in various disciplines, from urban morphology to transportation planning. Within this set of classifications, streets are generally organized into a hierarchy according to the primary function they perform within the urban system. This section also provides a brief description of three theories that sought to explain the location of retail activities in the city through an analysis of the urban form.

Road Classifications and Street Typologies

Route Typology (Caniggia and Maffei, 2001)

First of all, the Italian school of urban morphology identified four main types of routes and organized them into a hierarchical framework. A route is defined as a

"structure apt to provide access to a place, starting from another" (Caniggia and Maffei, 2001). These are the matrix route, the settling route, the connecting route and the break-through route.

The matrix route, which pre-dates urbanization, usually serves as the key vector of the urbanization process along which residential units are being built. This basic structure is then gradually completed by the implementation of settling routes and connecting routes, to form a denser urban structure. In a first set of circumstances, when the matrix route is centrally located, it usually becomes the local commercial street within the morphological unit. On the other hand, when located in a peripheral location and running along a natural barrier for instance, the matrix route is converted into a transportation route in order to ease access and movement within the urban environment and another centrally located route will emerge as the local commercial artery.

Figure 3. Route Types.

A – Matrix Route; B – Settling Routes branching off from original matrix route;
C – Connecting Routes link the settling routes; D – Breakthrough Route restructures existing tissues.

Source : Canniggia and Maffei, 2001

Ordinary vs. Specialized Streets (Caniggia and Maffei, 2001).

More generally, streets are often grouped into two main categories according to the function they perform within the street network. A key distinction is made between "ordinary" and "specialized" streets. The first type constitutes the majority of streets since they are dedicated to residential purposes. In contrast, "specialized streets" can be subdivided into two "sub-types": the "commercial street" and the "transportation street". In addition to their differences in terms of function, commercial and transportation streets also differ regarding their position within the street network. Theoretically, commercial streets are centrally located within a morphological unit whereas transportation streets usually constitute physical barriers, defining the spatial boundaries of the morphological area. Therefore, transportation streets are considered as peripherally located, and are mostly dedicated to provide access and ease of movement for motorists. However, within the framework of this research, this distinction is not so clear as a few commercial streets selected for this analysis may also be designated as transportation streets, hence combining both functions.

Conventional Road Hierarchies (Marschall, 2005).

Conventional road hierarchies were developed by both public and private institutions devoted to transportation planning and urban design. Although traffic, and more precisely the volume carried as well as the efficiency of traffic flow, is put first to designate roads or route types, other concerns such as safety, amenity, and the overall quality of the pedestrian environment are considered.

This conventional classification practice led to the emergence of a general spectrum ranging from "minor" to "major" roads. Also stemmed from this conventional classification the key distinction between "roads" and "streets". Roads are designated as streets when they imply built frontages and public space, and are normally found at the end of the spectrum, i.e. labeled as minor roads (Marschall, 2005).

Overall, when looking at the atlas of street hierarchies and typologies, a wide variety of street types can be observed across a diversity of urban contexts, especially because any particular street will tend to have multiple personalities along different sections. Consequently, street form, street use, street relation or street designation are the four main themes that are used to build street and road classifications, though they can also be combined (Table xx).

Set of Road Types	Classification Theme	Type of Theme
Limited Access road, distributor, Access Rod	Access Control	Form
Narrow Street, Wide Street	Width	
Civic, Commercial, residential, Industrial	Urban Building Type	
Shopping Street, Living Street, etc…	Urban Uses and Users	Use
High volume road, low volume road	Traffic volume	
Routes used by tourist traffic, work traffic…	Road Users	
Strategic Route, Link Route, Local Route, etc…	Strategic Role	Relation
Bus Only, Pedestrian Only, etc…	Vehicle or User Permission	Designation
"Avenue", "Street", "Lane", "Mansions", etc…	Nominal	

Table 3. A taxonomy of road types, classification themes and theme types.

Source: Marschall (2005), P. 54.

Within the framework of this taxonomy, roads and streets are defined in functional terms, meaning that roads are assessed based on the degree to which they exert the function of a transportation corridor. This characterizes, to a certain extent, the new urban structure, also defined as the "modern urban fabric" (Levy, 1999). In fact, the contemporary urban fabric has undergone radical changes in terms of its physical form. In addition to territorial expansion due to the growth of low-density and suburban developments, internal physical transformations were observed in its traditional structure. Therefore, performing a

morphological analysis of the street system in this urban context implies understanding the extent to which streets have been reduced to their sole transportation role by becoming a place for movement only (Levy, 1999).

Urban Form and Retail Location

As far as local commercial streets are concerned, not enough attention has been given in the literature to study the relationship between urban form and retail location. Yet, in an attempt to understand the underlying dynamics of local commercial streets and contribute to the success of commercial revitalization strategies, certain spatial determinants might be crucial to consider because they may also influence the spatial distribution of commercial activities and the overall level of retail activity. Applying different methods of analysis, a few recent studies have examined the relationship between some characters of the urban form and the location of retail and service activities. These are described as follows.

The Space Syntax Theory (Hillier, 1996)

First of all, the space syntax theory focuses on the concept of street connectivity to predict pedestrian activity and the level of retail activity. Street connectivity is examined through a combination of spatial characters such as the possible paths between two locations, the number of turns along a path as well as the length and width of streets. Space syntax research has established that, because they can be reached with fewer numbers of directional turns, streets with higher level of connectivity attract more people and therefore support retail and other land

uses. In other words, space syntax analysis has demonstrated that the more connected is the street, the more likely this street will become a commercial street. Translated in applied terms, this theory implies that a key measure to enhance the urban environment of a local commercial street is to increase its level of connectivity by providing more direct routes and more complete pedestrian facilities.

As such, street connectivity – or street permeability – may be a key factor underlying the location of retail activities along a commercial street and within the urban structure.

Street Centrality and Land Use Density (Porta et al., 2009)

Research was also recently conducted in Bologna, Italy, to explore the relationship between street centrality and the intensity of land uses, in this case measured as the densities of retail and service activities (Porta et al., 2009).

In this research, centrality is a key spatial attribute that shapes the urban structure, thereby accounting for the location and distribution of commercial and service activities in the city. Centrality is measured with the Multiple Centrality Assessment (MCA) tool which captures four aspects of centrality: Being central as being close (*closeness centrality*), being an intermediary (*betweenness centrality*), being accessible (*straightness centrality*), and being critical for the efficiency of the system (*information centrality*). Since the study demonstrated the existence of a relationship between street centrality and retail density (both commercial and service activities), street centrality is also to be carefully

considered as a powerful spatial determinant underlying retail location and retail intensity. While the development of a MCA tool for Montréal is beyond the scope of the current research project, centrality within a specific urban area – or morphological unit – is explored as a factor in commercial street vitality.

In addition, not only exploring the relationship between retail density and street centrality, this study attempts to distinguish the impact of spatial determinants on the location and density of both convenience and specialized retail.

The "Anchor" Theory"

A third approach explains the level of activity along a commercial street by the presence of a specific establishment such as a museum, a movie theater, a metro station, or a university. These attractors would act as a generator of commercial activities at specific hours of periods of time (during evenings for example), also inducing higher level of retail density in close proximity or along the entire street.

URBAN FORM AND TRAVEL BEHAVIOR

The purpose of this last section is to review the literature exploring the relationship between urban form, street configuration and people's travel behavior, more particularly non-work travel and shopping trips. This set of studies helps us to understand how and where commercial revitalization strategies should be designed.

New Urbanism, Neo Traditional Development, and Transportation Benefits

A large debate emerged over the relationship between urban form and travel behavior after Newman and Kenworthy (1989) revealed a negative relationship between density and energy use for a sample of international cities. The idea has emerged that urban policies aiming at shaping the built environment could or should be used to reduce automobile travel in cities (Handy, 2005).

Proponents of recent urban planning movements such as New Urbanism, Transit Oriented Development, Neo Traditional Development, Compact cities, and Smart Growth have proposed solutions and strategies to re-build communities and neighborhoods at "appropriate scales" so as to "mitigate environmental harms and perceived social inequities that arise because of scattered, low density urban form" (Greenwald, 2003:2). Essentially, this set of strategies attempts to reduce automobile travel, and improve pedestrian as well as transit access, by fostering sustainable, walkable and local communities built upon the design principles and model of the "traditional city" that prevailed at the end of the 19th – early 20th century (Crane, 2000). These also attempt to offer solutions to "the declining of neighborliness and civic responsibility" (Handy and Clifton, 2001:2).

Non-work Travel Behavior and Shopping Trips

Within the framework of this research, it is crucial to distinguish people's travel behavior based on trip purposes (Handy, 1996). Work travel refers to commuting trips, i.e. weekdays travel from home to place of work. In contrast, non-work

travel encompasses all types of trips related to social, personal, and recreational activities. Shopping trips are thus included in the second category. Until recently, most of the attention in the literature has been given to the effect of the built environment on commute travel, and less attention has focused on its impact on non-work travel (Cervero and Radisch, 1996; Rajamani et al., 2003).

Significance of Non-work Related Trips

Non-work related trips represent an increasing proportion of all trips made. Within American cities, work trips accounted for only 20.1% of all person trips and 22.7% of person miles traveled in 1990 (Pisarski, 1992). By contrast, social, recreational, family and personal trips accounted for 65.8% of person-miles traveled (Pisarski, 1992). An updated report of *Commuting in America* (Pisarski, 2006) confirms this trend since work trips accounted for only 16% of all travel in 2006 (Pisarski, 2006). Furthermore, contrary to popular belief, non-work trips represent an increasingly large proportion of peak period trips (Rajamani and al., 2003; Berman, 1996). Based on these figures, it can be stated that reducing the number or length of non-work trips made by automobile may lead to a substantial reduction of the total amount of travel (Berman, 1996).

Focusing on non-work travel when analyzing the impact of the urban form is even more relevant than looking at commutes since non-work related trips are regarded as being more flexible, and thus more responsive to morphological changes of the built environment (Berman, 1996; Handy, 1996; Rajamani et al., 2003; Krizek, 2003). In fact, as far as work travel is concerned, effects of Neo

Traditional design would be limited because these trips are more strictly defined and are less likely to vary in terms of route maps (Handy, 1996). In contrast, people often have different alternatives regarding their itinerary and timing for their non-work trips. Therefore, non-work related trips represent the greatest potential for shaping travel behavior through land use and neighborhood design strategies.

The special case of Shopping Trips

Also, within the specific framework of this research, particular attention is given to shopping trips. These trips account for about 10-15% of all trips made (Barber, 1995) and represent "one of the largest and most flexible segments of non-work trips" (Handy, 1996:4). By comparing the impact of new urbanism design principles on both work and non-work purposes, Cervero and Radisch (1996) concluded that "neighborhood design practices exert their greatest influence on local shopping trips and other non-work purposes" (Cervero and Radisch, 1996:1).

Based on these figures and assumptions, developing a better understanding on people's decision making process regarding where they shop, how far, how often and by which mode, has become crucial in the attempt to implement efficient transportation and land use strategies.

Selected spatial characteristics and their impact on travel behavior

In recent years, literature has explored the link between urban form and travel behavior and addressed the question "Does the built environment affect how often and how far people drive or walk or when they will take the train or the bus?" (Crane, 2000:1). In this attempt, several spatial characteristics have been examined to assess the extent to which they influence people's travel behavior within their neighborhood and more particularly to local commercial areas.

In 1976, Kain and Fauth conducted the first study that sought to explain urban travel behavior as a function of both economic circumstances and urban form. This study provided evidence that urban form matters. However, economic factors were found to be more decisive, namely that once people can afford a car, they usually drive to work "regardless of where they live, or the structure of their environment" (Kain and Fauth, 1976). Since then, various researchers have aimed at demonstrating that "creating more compact, diverse and pedestrian-oriented neighborhood, in combination, can meaningfully influence how Americans travel" (Cervero and Kockelman, 1997:1).

Density

Density is usually mentioned as the first spatial characteristic that influences the way people travel. Indeed, it is commonly argued that increasing the level of residential density will encourage people to walk for their daily activities since they will be able to reach a wider range of services and activities within a smaller radius of "travel". Numerous studies support the conclusion that higher densities

contribute to reduce Vehicle Miles Traveled (VMT) (Ewing, 1997; Burchell et al. 1998) and to increase transit use, especially when high-density developments are located near transit corridors (Hotzclaw, 1994; Dunphy and Fisher, 1996; Levinson and Wynn, 1963; 1000 Friends of Oregon, 1996; Kitamura, et al., 1997).

However, some authors have pointed out that that this approach to density is often inadequate. First, the population density of a neighborhood does not always show a significant association with modal choice (Soltani et al., 2006). Also, as a measure of the urban form, density results from complex processes and often masks variations in land use patterns and design between places that could feature the same density (Handy, 1996; Crane 1996; Dunphy and Fisher, 1996). Therefore, measures of density must be analyzed in combination with other measures of the urban form, such as diversity and spatial structure pattern (Tsai, Y.H, 2005). Furthermore, definitions and meaning of density is often subject to debate and discussion as they may vary according to the scale of analysis, ranging from the neighborhood level to the metropolitan level (Tsai, Y.H, 2005).

Land Use Mix

A significant number of studies were performed to determine whether a higher level of land use mix is positively correlated with lower levels of motorized travel. Increasing land use diversity by mixing residential, commercial, institutional and

recreational activities is one key objective of the strategies developed by urban planning movements.

Recent studies have demonstrated that increased mixity of land uses affects travel by reducing vehicle distances and thus vehicle times (Boarnet and Crane, 2001). Cervero (1996) concluded that commuters will definitely be more likely to use transit if they have the opportunity to stop, shop or engage in any other activities on the way home from the transit stop. Finally, mixed land use neighborhoods are often associated with higher levels of walking trips, for both work trips (Frank and Pivo, 1994) and non-work trips (Rajamani et al., 2003).

Street Pattern: Street Connectivity and Street Permeability

The Suburban vs. The Neo Traditional model of street layout

Street layout constitutes a third spatial characteristic alleged to influence people's travel behavior. Indeed, the literature has established a strong distinction between conventional loops and cul-de-sacs – which mostly characterize suburban areas – and more traditional grid model that consists in an interconnected street network as proponed by Smart Growth, New Urbanism and Neo-Traditional developments. The purpose is to verify whether the former pattern discourages pedestrian activity, while the second environment is more pedestrian-friendly. Several studies concluded that a connected grid street design reduces vehicle miles traveled by the residents in the community (Kulash et al., 1990; McNally and Ryan, 1993; Cervero and Kockelman, 1997) as it averages higher walking and bicycling modal shares that the more typical post

World War II residential developments (Cervero and Gorham, 1995; Crane and Crepeau, 1998).

Street Pattern and "Street Connectivity"

The study of the street pattern – the arrangement of streets and blocks – is closely related to the concept of "street connectivity", also referred to as "street permeability". Advocates of New Urbanism and Neo Traditional Development argue that increased network connectivity can reduce travel distances for all modes, including walking and bicycling, as well as providing pedestrians a wider range of routes (Dill, 2003).

Defining and Measuring Street Connectivity

A highly connected – or permeable – pedestrian network is defined as "having formal and continuous pathways that allow direct and safe pedestrian travel between residential and commercial parcels" (Hess et al., 1997:1). In contrast, a low permeable street network is characterized by a lack of direct, continuous, and safe pedestrian systems (Hess et al., 1997).

Measuring street connectivity is based upon the combination of two physical distance measures: the route directness (pedestrian route directness ratio) and the completeness of pedestrian facilities (Hess et al., 1997) or the route distance (Randall and Baetz, 2001). Other measures of street connectivity include: intersection density, street density, block density, connected node ratio, linked node ratio (Dill, 2003). According to Hess (1997), variations in pedestrian volume

between urban and suburban neighborhoods may be explained by the differences in street connectivity (Hess et al., 1997; Hess, 1997). Therefore, improvements to the pedestrian environment through the provision of more direct and shorter routes may discourage car trips, while stimulating walking trips within the neighborhood (Randall and Baetz, 2001). Moreover, as described above, space syntax theory uses streets connectivity as a key concept for exploring our everyday use of space. Space syntax research established that higher level of connectivity is associated with higher level of pedestrian traffic and activity, also supporting the development of retail activities along these most connected streets. Finally, the quality of the links between commercial and residential areas is also of great influence in consumers' decision to walk to the closest store (Handy, 1996).

Therefore, for the purpose of this research, street connectivity – or street permeability – is regarded a key spatial determinant underlying the spatial distribution of commercial activities.

Accessibility

Accessibility is another key feature for "exploring the link between the spatial structure of a community and its region and the travel patterns of its residents" (Handy, 1992:5).

According to Hansen (1959), the concept of accessibility reflects the "intensity of the possibility of interaction". Handy (1996) argues that this notion is used to characterize urban form in terms of choices (of destinations) provided. In diverse

studies, Handy analyzed the impact of accessibility by focusing on shopping trips to local commercial areas (Handy, 1992; 1993; 1996a; Handy and Clifton, 2001). For the purpose of her research, Handy has established a key distinction between "Local Accessibility" (LA) and "Regional Accessibility" (RA): "Local Accessibility" is defined as being "primarily determined by nearby activity" and the prevalence of convenience stores located in small centers. Therefore, trips associated with a high level of local accessibility are meant to be shorter and more frequent. In contrast, "Regional Accessibility" is defined with respect to "large regional shopping centers which tend to be farther away and offer a wide range of comparison goods" (Handy, 1992:5). In this case, the travel pattern of regional accessibility reflects longer and more infrequent trips (Handy, 1992). Consequently, as a spatial characteristic, accessibility is measured as a combination of proximity, density and street pattern (Handy, 1996).

Handy concluded that higher levels of accessibility, both local and regional, of a specific location are generally associated with a decrease in the total amount of travel, due to shorter trips distances. Similar conclusions were reached by Hotzclaw (1994) and Cervero and Kockelman (1997) whose results revealed that "residential neighborhoods that were spatially accessible to commercial activities, tended to average appreciably less VMT per household" (Cervero and Kockelman, 1997:19).

Finally, Handy emphasizes the need to take into consideration both local and regional levels of accessibility to reduce automobile travel within Neo Traditional Development (NTD) strategies. Her findings demonstrated that the potential to

reduce miles traveled by increasing local accessibility is greater when the level of regional accessibility is low (Handy, 1992). These conclusions highlight that reducing automobile trips within NTD developments not only depends on the quality of the local environment but is also affected by the spatial structure at the metropolitan or regional level (Berman, 1996)

Although this research does not explore the relationship between accessibility and retail location, these findings are crucial for the purpose of this study since they point out the necessity to combine local spatial characteristics (local accessibility, and local connectivity/permeability) with more regional and larger considerations regarding the position of the local commercial street within the urban area. These results also reaffirm, to a certain extent, the relationship established by the central place theory between the location of a retail structure and the category of retail activity. Therefore, such results provide an interesting basis for comparison as this study seeks to investigate the impact of street centrality and street permeability on retail location along Montréal's commercial streets.

The distinction between local accessibility and regional accessibility is also crucial for understanding shopping trip patterns. Investigating relationships between urban form, retail activities and transportation behavior constitutes a key theme for further research.

Urban Form and Travel Behavior: A relationship that remains unclear, complex and ambiguous.

Despite the popularity of Neo Traditional developments, there remains a large debate about the feasibility as well as the validity of the transportation benefits promised by their proponents. Indeed, the impact of urban design and urban form on people's travel behavior, more particularly regarding shopping trips, requires further investigation. Some of the contentious questions are as follows.

First, methodological issues in studying the land use – transportation connection have been discussed. Owing to the increasing complexity of consumers' shopping behavior, a more behavioral approach to trip patterns should be favored (Crane and Crepeau, 1998). Also, the majority of the studies have failed to separate out the individual impact of each spatial characteristic. The complexity of the spatial structure, as a continuously changing organism, constitutes one of the main impediments to these studies (Crane and Crepeau, 1998). Furthermore, Crane (1996) suggested that in terms of travel, land use practices promoted by New Urbanism could actually backfire and increase the total amount of travel. In fact, if trips become less costly because they are shorter, the demand for trips is expected to rise. "Whether people end up driving more if trips are shorter depends on the elasticity of trip demand with respect to its costs" (Crane, 2000:15).

More specifically, with regard to shopping trips, the argument behind New Urbanism strategies is that providing local commercial areas or local stores will encourage people to walk for most of their shopping trips. However, Handy and

Clifton (2001) demonstrated the limited effectiveness of such strategies as they contend that shopping trips are mostly associated with short distances. Besides, walking trips to commercial areas are often supplemental to driving trips. Finally, residents often bypass the closest store in favor of other shops offering a wider selection of goods, a better ambiance, or better prices. Individual preferences and motives may affect more significantly people's decision for their shopping trips than the local retail structure.

Finally, the issue of "substitutability" is often discussed within the debate about the merits of New Urbanism transportation strategies. In fact, "past research is unclear about whether high rates of short, within-neighborhoods shopping and social-recreational trips by non auto modes actually replace longer, out-of-neighborhood auto trips, such as to regional shopping centers" (Cervero and Radisch, 1996:14). Walking to a store may just be taken as an excuse to walk and personal motives often explain again a great part of this decision (Handy & Clifton, 2001). In addition, it is complex to determine whether trips to downtown replaced or were made in addition to regional shopping centers. (Handy, 1992; Handy and Clifton, 2001).

CONCLUSION

Within the framework of this research, the body of literature covered in this chapter suggests that a number of considerations are important to investigate in

order to understand the impact of urban form on the location and spatial distribution of services and amenities along commercial arteries in Montréal.

First of all, through a morphological approach, this research seeks to explore whether the relationship between retail location and retail activity that characterizes the hierarchical model of urban retailing still holds in the context of the modern urban fabric, where a variety of retail formats serving different shopping purposes and clienteles coexist.

Second, this research is based on previous studies that demonstrated the significance of street connectivity and street centrality as two spatial characters of the urban form underlying retail location and retail spatial distribution along the commercial artery as well as within the urban structure. Taking Montréal as a case study, this research focuses on the relative position of the commercial street and its level of permeability to explore an analogous relationship.

Third, classifications of consumer goods and services as well as retail outlets developed in the retailing and marketing literature served as a framework for characterizing Montréal's commercial arteries according to their dominant retail profile. This research distinguishes convenience from specialized retail, the latter category including both shopping and specialty goods and services. Not only this research explores the relationship between urban form and retail location, it also attempts to distinguish the impact of spatial determinants on the spatial distribution of both convenience and specialized retail.

Finally, when located along a commercial street or in close proximity, attractors or anchors are suspected to act as a generator of commercial activities.

In addition to these considerations, there are a number of other factors and characteristics that are not explored fully in this research, namely inaccessibility, density, etc. These are suggested as themes for further research in order to complement this preliminary study.

CHAPTER 3 – METHODOLOGY

PURPOSE

As the primary objective of this research consists in exploring the impact of spatial determinants on the spatial distribution of retail activities in Montréal, a morphological analysis of commercial streets was undertaken. This spatial analysis was used to develop a typology of commercial streets based on both (a) commercial and (b) morphological characteristics.

Performing such an analysis requires successive processes of data collection and data preparation, as described in the following two sections.

DATA COLLECTION

Selecting a sample of commercial streets, Sherlock Database, City of Montréal.

The first step of the analysis was to select a significant sample of commercial streets in Montreal. In this attempt, the City of Montreal's online database, Sherlock[2], was used. This website provides a detailed list of commercial arteries for each borough.

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[2] Sherlock – La Banque d'Information Municipale:

http://www11.ville.montreal.qc.ca/sherlock2/servlet/template/sherlock%2CRechSherlock.vm

According to the City of Montréal, a "commercial artery" is defined as "a concentration of a minimum of 50 commercial establishments located on a section of a Montreal's street. In general, this section is no longer than 1 km in length". Often, these commercial arteries benefit from:

- Occasional street activities such as street market, Christmas parades, etc.
- The setting up of a Business Development Association (SDC: *Société de Développement Commercial),* which is a non-profit association aimed at the economic development of selected commercial arteries or neighborhoods.

The Sherlock database delineates commercial arteries in spatial terms, i.e. using street intersections, which can then be matched with exact civic codes. The inventory of commercial arteries was combined with the territory upon which the 2000 Census of Commercial Establishments was conducted, corresponding to the spatial limits of Montréal before the municipal merger. In total, 85 commercial streets[3], spread over 9 boroughs, were selected as the sample upon which the morphological analysis will be carried out.

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[3] Saint Catherine Street was excluded from this study as it was not listed as a commercial artery for the borough of Ville-Marie.

For a complete list of commercial streets, see Annex 1.
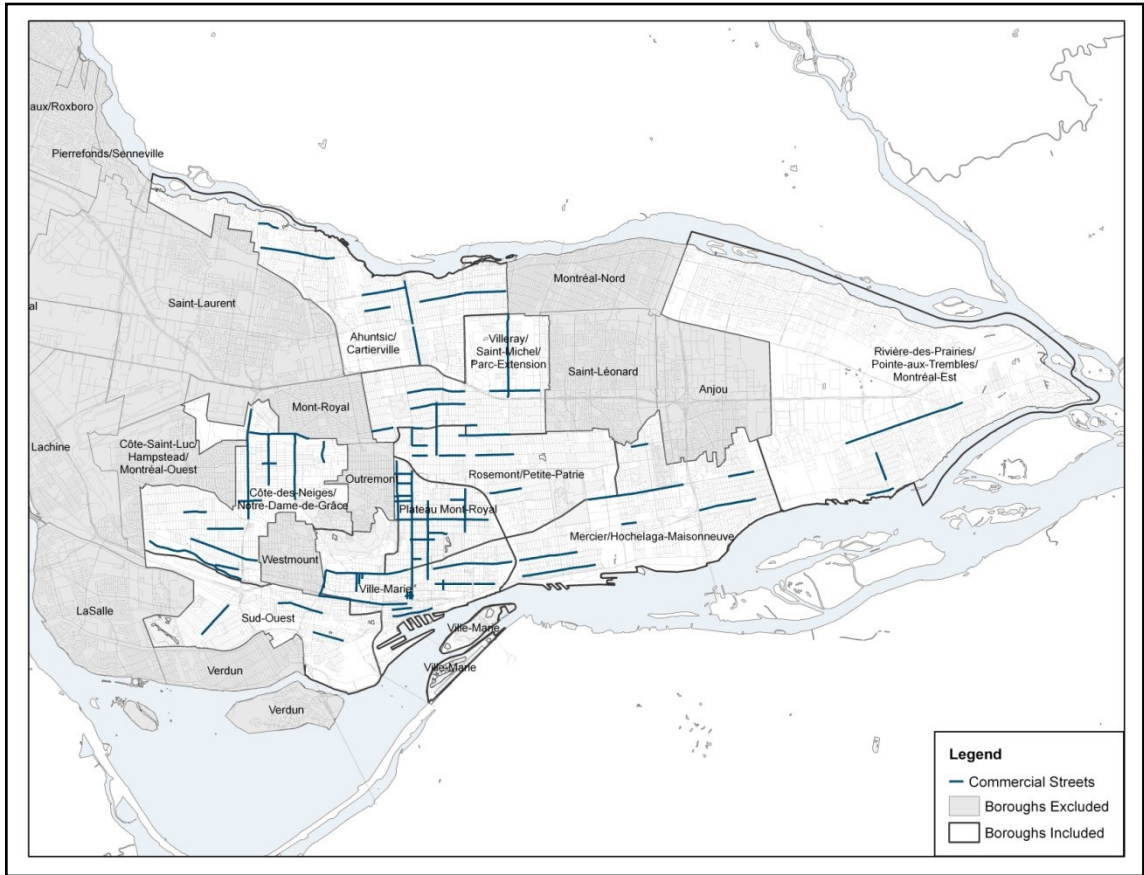
Figure 4. Map of the Study Area.

Census of Commercial Establishments, REEM 2000.

The Census of Business and Employment[4] produced by the City of Montréal in 2000 was used as the database for listing all the commercial establishments present along the 85 commercial arteries previously selected. This database lists all commercial establishments located on more than 2,000 streets in the Montreal territory before the municipal mergers. For the purpose of this census, an "Establishment" is defined as "the smallest operational entity that produces goods and services, which has at least one paying job and a specific geographical location. It may be one or several buildings on a same site, or an area inside a building". This census also provides "general information on the establishments, including business name, street and Internet address, telephone and fax number as well as the main economic activity and the number of employed at the establishment at the time of the census".

The search engine available in the REEM Database allowed us to search for commercial establishments by "Street Addresses", i.e. by mentioning the street name as well as the civic codes corresponding to the commercial section of the street. The list of matching results was exported in an Excel file to perform an individual analysis of the 85 commercial streets, also leading to the production of 85 detailed commercial inventories. Within the REEM database, businesses were ordered into nine main categories, based the nature of the activity conducted by the establishment. These categories were then subdivided into more than 2,000 subcategories. Without losing the pertinence of this very detailed classification,

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[4] REEM, 2000 : Recensement des Établissements et de l'Emploi à Montréal, 2000.

commercial inventories were examined and analyzed through the lens of the REEM classification in order to characterize a commercial street according to its dominant category of retail activity.

Figure 5. REEM Database – Search Engine

DATA PREPARATION

Commercial Offer Typology

To document the spatial distribution of retail activities, a classification of the commercial offer was developed. Commercial arteries were distinguished according to the dominant type of goods and services present along the street.

As mentioned in the literature review, the commercial offer is usually divided into two main categories: "convenience retail" and "specialized retail". These

categories include both retail activities and commercial services. As a reminder, the convenience retail category includes all commercial establishments that mostly provide daily goods, necessities and services. These are usually centrally located, easily accessible and associated with short and more frequent trips. On the other hand, the specialized retail category includes all commercial establishments defined as "comparison outlets", namely those stores that sell both shopping or specialty goods and services, implying a certain decision-making process. Such outlets provide a wider range of goods, and usually correspond to a specific shopping trip purpose.

In order to characterize commercial arteries according to their dominant category of commercial offer, the 85 commercial inventories produced were carefully scrutinized in association with the REEM categories and subcategories.

As said, within the REEM database, each category of businesses and commercial establishments were sorted out by 9 main categories and more than 2,000 subcategories. These subcategories were all coded according to the type of activity provided. These codes were then matched with the two main commercial offer categories (convenience and specialized). However, in order to have a more detailed picture of the nature of the commercial offer in Montréal, five subcategories were distinguished:

- **Convenience Retail**
    - *1100 – Convenience Goods*

Dépanneurs, supermarkets, bakeries, pharmacies, etc.

- ▪ *1200 – Convenience Services*

  Banks, postal services, video rental, limited-service eating places, etc.

- **Specialized Retail**

  - ▪ *2100 – Specialized Goods* (Both Shopping and Specialty)

    Hardware Store, clothing, furniture store, department store…

  - ▪ *2200 – Specialized Services* (Both Shopping and Specialty)

    Personal and health care services, hairdresser, beauty salon, insurance services, consulting…

  - ▪ *2300 – Food Services*

    Full-time restaurants and drinking places

Nevertheless, within this classification-building process, a few categories of commercial activities required particular consideration:

- ▪ First, with regard to "food services and drinking places", these establishments were not considered as a distinct category but as a subcategory of either convenience or destination services. A distinction between "full time restaurants" and "limited service eating places" seemed necessary: the former category is to be considered as a "Destination service" because these commercial places represent a particular destination resulting from a thoughtful decision. These restaurants were combined with the "drinking places" category to form a specific

subcategory entitled "Destination Food Services". On the other hand, "limited eating places" such as coffee shops, fast foods, or sandwich shops were placed into the category of "convenient services" inasmuch as these establishments are associated with a more spontaneous behavior and a more frequent activity.

- The second problematic category concerns "public utilities" such as postal services, hospitals, museums, public parks, libraries, movie theatres, and educational services (schools, universities). For the purpose of this research, postal services were considered as convenient services, whereas facilities such as museums, libraries, or movie theatres fell into the special category of "Attractors". More precisely, these facilities are worth considering inasmuch as they likely influence the level of activity of a commercial street by attracting a higher number of people at a specific time (i.e. movie theatres). This explains why these establishments must be singled out and were identified as "anchors", "attractors", or even "generators".

  Finally, metro stations were also included into the "attractor" category and will be the subject of an individual analysis.

Convenience Retail	Specialized Retail	Attractors
• 1100 - Convenience Goods • 1200 - Convenience Services	• 2100 - Specialized Goods (Both Shopping and Speciality) • 2200 - Specialized Services (Both Shopping and Speciality) • 2300 - Food Services (Full-time Restaurants and drinking places)	• Elementary and Secondary Schools / Universities • General Hospitals • Non Commercial Art Museums /Historic and Heritage Sites • Libraries • Motion Picture and Video Exhibition • Metro Station

Figure 6. Commercial Offer Classification

Spatial Data Preparation

The second major step to carry out the morphological analysis consisted in collecting spatial and morphological data. More precisely, the spatial analysis was performed using the Geographic Information System, ArcGIS 10®. The data collected are stored in a specific format in several separate datasets:

1. An ArcGIS polyline shapefile including Montréal's street network.

Two separate layers containing the 85 commercial streets were extracted from this dataset. Commercial streets were geocoded in ArcGIS® according to the civic codes and street intersections mentioned in the City of Montréal database.

- A first dataset considers commercial streets as individual entity composed of one unique segment. This layer hence contains 85 features (n=85).

  This dataset was used to examine the spatial distribution of retail activities on a global scale. Numerical measures were extracted for characterizing the commercial street as a whole, which further allowed for comparisons between streets based on their dominant category of commercial offer, their retail density, and level of permeability.

- A second dataset considers commercial streets as a sequence of street segments. This street network contains a total of 1,193 street segments (n=1,193).

  This dataset was used to perform a finer analysis, looking at the spatial distribution of commercial activities per street segment, allowing for local variations in the spatial distribution of retail activities along the street to be captured.

2. An ArcGIS point shapefile including all commercial establishments located along the selected commercial arteries (n=11,389 - Attractors included).

   Based on the addresses available in the REEM database and using the address locator tool available in ArcGIS®, each commercial establishment was geocoded along the appropriate commercial street. Again, three separate layers were extracted from this dataset:

- One layer containing all convenience retail commercial establishments (n=2,042);

- One layer containing all specialized retail commercial establishments (n=9,273);

- One layer containing all attractors (n=74)

In addition, in order to have a more accurate representation of the spatial environment surrounding commercial arteries, additional datasets were exploited:

3. An ArcGIS point shapefile containing all metro stations locations in Montreal (STM Transit Data, 2007).

4. An ArcGIS polyline shapefile containing parks, recreation, cemeteries, sports field, garden, etc. in Montreal. (DMTI Spatial Inc., CanMap Parks and Recreation, 2009).

5. An ArcGIS polyline shapefile containing major roads and highways. (DMTI Spatial Inc., CanMap RouteLogistics, 2010).

6. An ArcGIS polyline shapefile containing all rail infrastructure currently in operation, including railway lines classified as abandoned, mainline railway networks, transit lines, sidetrack, railway tunnels and bridges, etc. (DMTI Spatial Inc., CanMap Rail, 2010).

A cartographic representation of all these datasets allowed for visualization of the street layout surrounding each commercial street and identification of major

physical barriers – both natural and artificial – that may hinder the development of retailing activities within the study area.

The spatial data analysis was performed using the Geographic Information System software, ArcGIS 10®. For the purpose of this study, a few relevant spatial characteristics pertaining to the relative position and the level of permeability of the commercial street were qualified and quantified in order to assess their impact on the spatial distribution of commercial activities. This software allowed for visual assessment of spatial processes, as well as for more sophisticated methods of calculations to analyze data distributions.

This chapter described the general methodological approach used to perform the research analyses. More descriptive and detailed methodological specifications will be presented in the introduction section of the chapters presenting the research results.

CHAPTER 4 – RESULTS

INTRODUCTION: COMMERCIAL STREETS TYPOLOGY

As part of this research, a typology of commercial streets was built upon a combination of commercial and morphological characteristics. This classification serves as an introduction to the results chapter as it provides a general framework for understanding the analyses and results presented in the following sections. It also provides a general overview of the variety of spatial environments that characterize Montréal's commercial arteries.

Examining these streets at both the global and local level allows for highlighting the existence of similarities and variations regarding their retail functions and spatial layout. Commercial streets were then organized into four main categories according to the consistencies observed in the spatial distribution pattern of their retail activities.

Category of Commercial Streets	Key Characteristics
Traditional commercial arteries	Local Catchment Area (neighborhood); Predominance of convenience retail activities.
Specialized-retail oriented Streets and Major transportation arteries	Wider catchment area (regional); Combination of commercial and transportation functions; Automobile-oriented spatial environment.
Major shopping arteries	Major shopping destinations in Montréal; combination of commercial and transportation functions.
Set of distinctive configurations	Clusters of commercial streets forming a tight network; may also be touristic destinations. Examples: Chinatown, Jean Talon market, Downtown Entertainment District, among others

Table 4. Commercial Streets Typology

1- The first category refers to local and more traditional commercial arteries, usually referred to as the "local Main Street". These constitute the majority of our sample of 85 commercial streets and remain today a strong fixture in the Montréal's urban landscape.

These commercial streets usually provide convenience goods and services to a local catchment area. Generally centrally located within the neighborhood they intend to serve, they are also well integrated within the street network. Benefiting from higher levels of permeability and/or connectivity, these arteries support pedestrian activity. Furthermore, in terms of retail spatial distribution, they share a consistent pattern as convenient stores usually concentrate along highly permeable segments. The presence of some spatial determinants such as a

metro station, a park, a physical barrier or an intersection may disrupt the spatial distribution of commercial activities within the street.

Streets that were identified as "traditional commercial arteries" are listed in the table 5. Pictures are also provided to illustrate the predominant spatial environment that characterizes these commercial streets (Fig. 7 to 10).

• Avenue Darlington (CDN-NDG)	• Rue Fleury Ouest (AC)
• Avenue du Mont Royal (PMR)	• Rue Hochelaga (MHM)
	• Rue Jarry Est (Saint Laurent – Papineau) (VMPE)
• Avenue Laurier Est (PMR)	
• Avenue Laurier Ouest (PMR	• Rue Jean Talon Est (VMPE)
• Avenue Monkland (CDN-NDG)	• Rue Jean Talon Ouest (VMPE)
	• Rue Masson – *SDC Promenade Masson* (RPP)
• Avenue Somerled (CDN-NDG)	
• Avenue Van Horne (CDN-NDG)	• Rue Notre Dame Ouest (SO)
• Avenue Victoria (CDN-NDG)	• Rue Ontario Est (MHM)
• Boulevard Monk – *SDC La Nouvelle Avenue* (SO)	• Rue Ontario Est SDC (MHM)
• Chemin Queen Mary (CDN-NDG)	• Rue Ontario Est (VM)
• Chemin Upper Lachine (CDN-NDG)	• Rue Saint Hubert – *SDC Plaza Saint Hubert* (RPP)
• Rue Amherst (VM)	• Rue Saint Hubert (VMPE)

• Rue Beaubien (RPP)	• Rue Sainte Catherine Est (MHM)
	• Rue Sainte Catherine – *SDC Promenade Sainte Catherine* (MHM)
• Rue Bélanger (RPP)	
• Rue du Centre (SO)	• Rue Sainte Catherine Est (VM),
	• Rue Sherbrooke Ouest (CDN-NDG)
• Rue Fleury Est (AC)	
• Rue Fleury Est – *SDC Promenade Fleury* (AC)	• Rue Villeray (VMPE)

Table 5. Category 1: Traditional Commercial Arteries.

Figure 7. Boulevard Monk, SO.

Source: Google StreetView 2011.

Figure 8. Avenue Monkland, CDN-NDG.

Source: Google StreetView 2011.
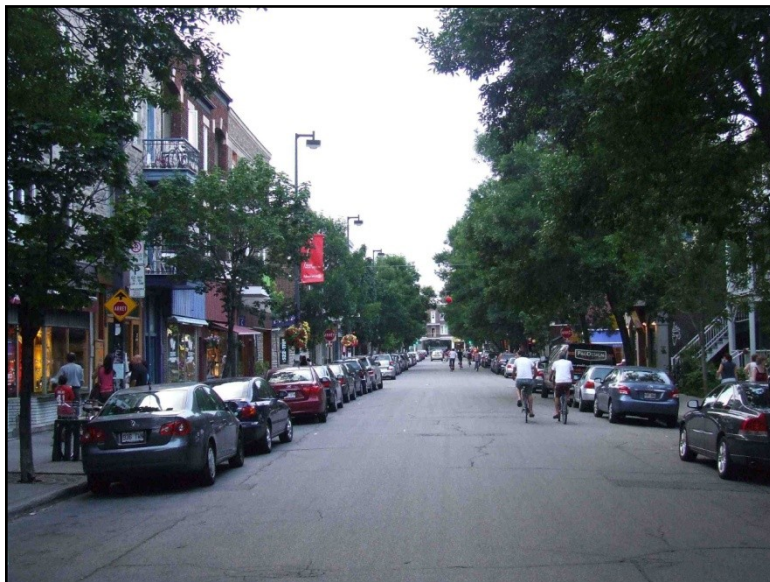
Figure 9. Rue Laurier Est, PMR.

Source: David Maloney, 2011.

Figure 10. Rue Villeray, VMPE.

Source: Google StreetView 2011.

2- The second category includes specialized retail oriented streets and major transportation arteries. In most cases, these are located in a peripheral position, i.e. either along a major artery or at the border of two morphological units so as to serve a wider catchment area. These streets combine both commercial and transportation functions as they generally act as major arteries and thoroughfares in the street network. These arteries have a predominantly automobile-oriented environment, favoring car accessibility over pedestrian activity.

Streets that were identified as "specialized retail oriented streets and major arteries" are listed in the table 6. Again, pictures are provided to illustrate the

predominant spatial environment that characterizes these commercial streets (Fig. 11 and 12)

• Avenue Atwater (VM)	• Rue Jarry Est (D'iberville – Pie IX) (VMPE)
• Avenue Papineau (PMR)	• Rue Jean Talon Ouest (CDN-NDG)
• Avenue du Parc (PMR)	• Rue Lajeunesse (AC)
• Boulevard Décarie (CDN-NDG)	• Rue Notre Dame Est (RDP)
• Boulevard Gouin Ouest (AC)	• Rue de Salaberry (AC)
• Boulevard Henri Bourassa (AC)	• Rue Saint Antoine (VM)
• Boulevard Saint Jean Baptiste (RDP)	• Rue Saint Jacques (CDN-NDG)
• Boulevard Saint Michel (VMPE)	• Rue Sherbrooke Est (MHM)
• Chemin de la Côte des Neiges (CDN-NDG)	• Rue Sherbrooke Est (RDP)
• Rue Beaubien Est (MHM)	• Rue Sherbrooke Ouest (VM).

Table 6. Category 2: Specialized Retail Oriented Streets and Major Arteries.

Figure 11. Rue Saint Jacques, CDN-NDG.

Source: Google StreetView, 2011.

Figure 12. Avenue Papineau, PMR.

Source: Google StreetView, 2011.

3- The third category includes commercial arteries that are recognized as major shopping destinations serving a wider and regional catchment area. These commercial streets are strong fixtures in the street network as they also serve key transportation functions. Although listed as a traditional commercial artery, Mont Royal Avenue may also fall into this category as this artery attracts shoppers and customers from outside the Plateau neighborhood.

• Boulevard Saint Laurent (PMR, VM)	• Rue Saint Denis (PMR, VM)
• Avenue du Mont Royal (PMR)	

Table 7. Category 3: Major Shopping Destinations

Figure 13. Avenue du Mont Royal, PMR.

Source: David Maloney, 2011.

Figure 14. Rue Saint Denis, PMR.

Source: Google StreetView, 2011.

4- Finally, the last category encompasses a set of distinctive configurations that should be regarded as "exceptions", or "variants". These commercial streets are clustered and often take the form of a tight network. They also correspond to major touristic destinations in Montréal and have benefited from specific planning measures.

Configurations / Neighborhoods	Commercial Streets
Old Montréal – Old Port	Rue Notre Dame Ouest, *SDC du Vieux Montréal* (VM); Rue Saint Paul (VM) (Fig. 15).
Chinatown	Boulevard Saint Laurent (VM) (Fig. 16); Rue Clark (VM); Rue de la Gauchetière (VM); Rue Saint Urbain (VM).
Jean Talon Market – Little Italy	Boulevard Saint Laurent (RPP) (Fig. 17); Rue Jean Talon Est (RPP); Rue Saint Zotique (RPP).
"Entertainment District" – Downtown	Rue Crescent (VM) (Fig. 18); Rue Bishop (VM); Rue de la Montagne (VM).
Plateau Area	Rue Prince Arthur (PMR); Rue Duluth (PMR); Rue Rachel (PMR).
Mile End	Rue Bernard (PMR); Rue Saint Viateur (PMR) (Fig. 19); Rue Fairmount (PMR); Avenue du Parc (PMR).

Table 8. Category 4: Distinctive Configurations of Commercial Streets

Figure 15. Rue Saint Paul Est, Montréal Old Port, VM.

Source: Google StreetView, 2011.

Figure 16. Boulevard Saint Laurent, Chinatown, VM.

Source: Google StreetView, 2011.

Figure 17. Boulevard Saint Laurent, Little Italy, RPP.

Source: Google StreetView, 2011.

Figure 18. Rue Crescent, VM.

Source: Google StreetView, 2011.

Figure 19. Rue Saint Viateur, Mile End, PMR.

Source: Julie Villain, 2011.

CHAPTER 4-1. GLOBAL CHARACTERIZATION OF COMMERCIAL SREETS

CHARACTERIZATION OF COMMERCIAL OFFER

Predominant Category of Commercial Offer: Convenience vs. Specialized Retail Oriented Streets

This first section of the results provides a general picture of the commercial activities that can be found along Montréal's commercial streets. The commercial street is analyzed as a whole, i.e. as one entity of the urban structure. Spatial variations that could occur at this point along different segments of a given street are not taken into consideration.

This analysis leads to a first classification of commercial streets based on their dominant category of commercial offer. Three categories are identified: convenience retail oriented streets, specialized retail oriented streets, and mixed retail streets.

Methodology

Based on the commercial inventories that were prepared for each of the 85 commercial streets, the proportion of commercial establishments present in each of the two categories was calculated and represented as a bar graph (Fig. 20).

AVENUE LAURIER EST : De la rue Brebeuf (1258) à la rue Papineau (1772)

RETAIL CATEGORY	Number of Commercial Estab.	Proportion
Total Number Places of Businesses	52	
TOTAL CONVENIENCE RETAIL	14	**26,92**
TOTAL DESTINATION RETAIL	38	**73,08**

Rue Laurier Est

11	3	14	15	9

0%   10%   20%   30%   40%   50%   60%   70%   80%   90%   100%

■ Convenient Goods   ■ Convenient Services   ■ Destination Goods
■ Destination Services   ■ Food Services
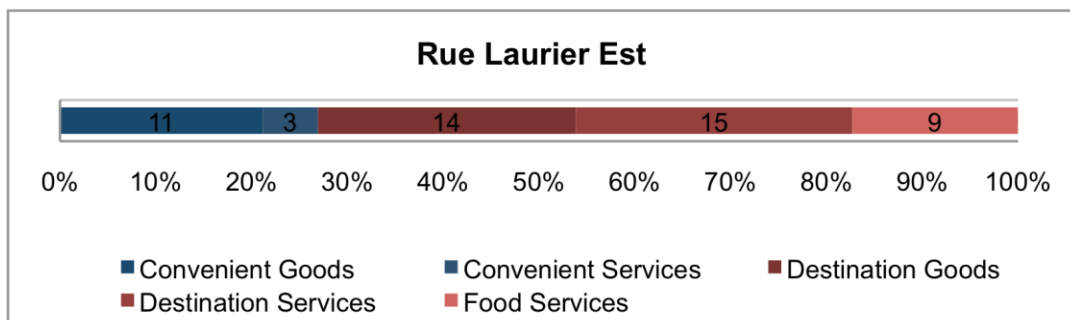
Figure 20. Sample of Commercial Inventory

These proportions were used to characterize the streets according to their dominant category of retail offering, namely convenience or specialized retail oriented. A third category, labeled as "mixed retail", was also established for commercial streets where no preeminence of one of the two categories could be observed.

Analysis

In order to compare the proportion of convenience and specialized establishments, attractors were excluded as they can not be associated with any

of the two categories of commercial offer. Attractors will be the subject of an individual analysis in the second part of this research.

Looking at the set of descriptive statistics delivered a first surprise (Table 10): the relatively low proportion of convenience retail found along Montréal's local commercial streets. On average, only 20.38% of the commercial establishments located on commercial streets provide convenience goods and services. The proportion of convenience retail establishments ranges from 0% to 55.17%. For instance, rue de la Montagne (VM) does not have any convenience stores, in contrast with Darlington Avenue (CDN-NDG) which features the highest proportion of convenience retail and is the only street that has more convenient stores (16) than specialized ones (13).

Looking at the frequency histogram (Fig. 23), a greater concentration of commercial streets with a proportion of convenience stores between 12% and 24% of the total amount of commercial establishments can be observed. Indeed, out of the 85 commercial streets, 46 (i.e. 54%) have a proportion of convenience retail falling into this range.

Classification

While taking into consideration the limitations discussed in the previous paragraph, an initial classification of commercial streets was built according to their retail profile. The following classification groups the commercial streets

according to this shared attribute, their dominant commercial offer, while trying not to lose the identity and uniqueness of each of these commercial arteries.

The classification is built upon the proportion of commercial establishments providing convenience goods and services. Looking at the frequency histogram (Fig. 23), the decile method was deemed the most appropriate to distinguish three categories of commercial streets. It also allowed for an equal number of convenience and specialized oriented streets (both 30% of our sample), facilitating further comparisons and analyses. The three categories are described as follows:

- *"Convenience retail oriented streets"* have a proportion of convenient establishments between 24.00% and 55.17%. These 25 commercial streets correspond to the "top" 30% of the distribution, i.e. deciles 70 to 100.

- *"Specialized retail oriented streets"* have the lowest proportion of convenience retail, ranging from 0.00% to 15.57%. Conversely, these 25 commercial streets have the highest proportion of specialized retail (Deciles 0-30).

- *"Mixed retail streets"* are the 35 remaining streets which have a proportion of convenience retail ranging from 15.58% to 23.99%, and for which no preeminence of commercial offer could be deduced.

LABEL	RANGE - Deciles	Proportion of Conv. Retail (%)	Nb of Commercial Streets
CONVENIENCE RETAIL ORIENTED	Deciles 70 – 100 (Top 30%)	24.00 – 55.17	25
MIXED RETAIL	Deciles 30 – 70 (40%)	15.58 – 23.99	35
SPECIALIZED RETAIL ORIENTED	Deciles 0 – 30 (Low 30%)	0.00 – 15.57	25

Table 9. Classification of commercial streets based on the dominant category of commercial offer.
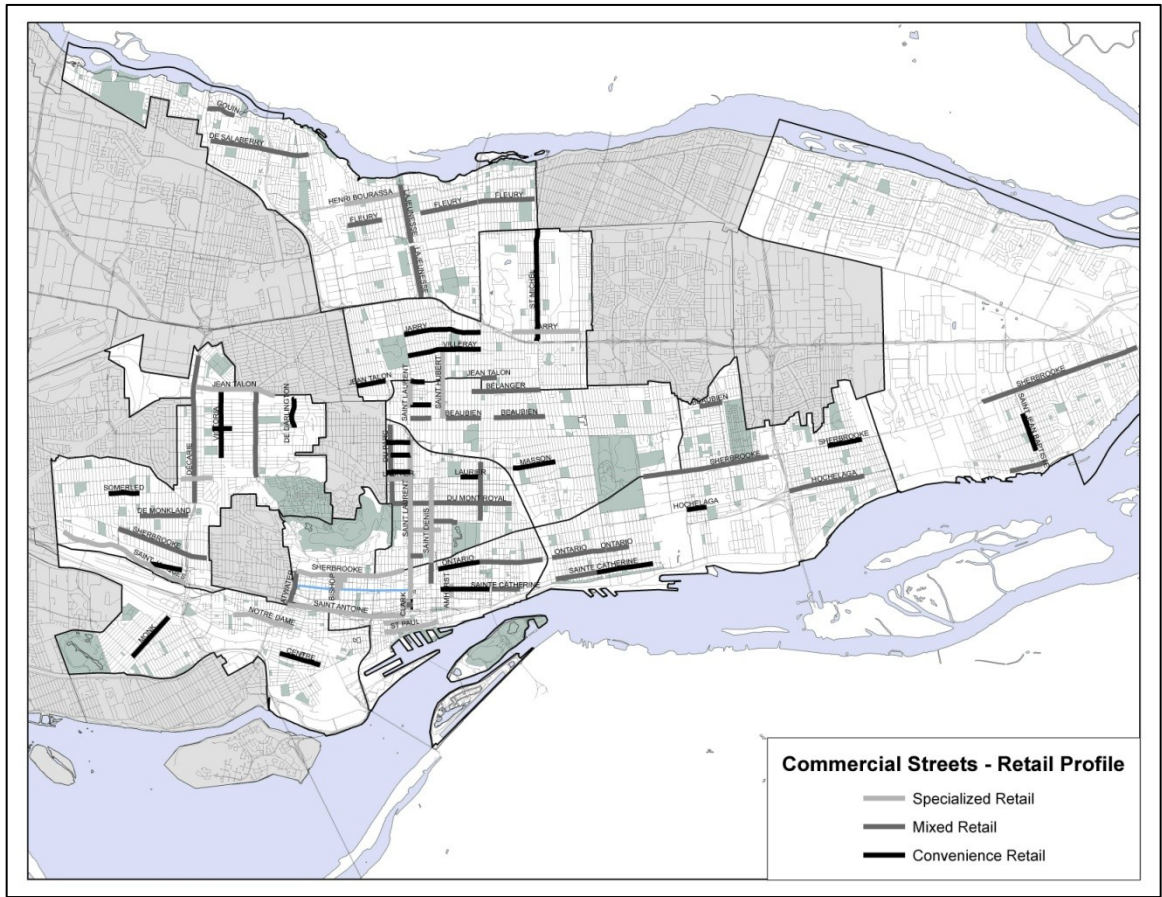
Figure 21. Montréal's Commercial Streets categorized by Retail Profile.

Discussion

General considerations stem from these initial results and preliminary classification.

First of all, the low proportion of convenience retail, in comparison to specialized retail (table 10), can be explained by the definition of commercial establishments used in the REEM census database. A "commercial establishment" is the "smallest operational entity that produces goods and services, which has at least one paying job and a specific geographical location. It may be one or several buildings on a same site, or an area inside a building". Therefore, a very wide variety of services are included in this census. As a consequence, downtown office towers located on some of the commercial streets feature very high number of specialized establishments, providing specialized services essentially, as compared to convenience ones.

Furthermore, this preliminary analysis provides a basis for the second-tier analysis that will be performed on a finer scale, and will focus on "internal" street segments in order to understand how this "20%" is distributed over a commercial street. This examination is particularly significant as commercial streets in the census also vary in length. Such an analysis will emphasize the presence of local variations within a commercial street that displays different retail profiles depending on the street segments considered.

	CONVENIENCE RETAIL ESTABLISHMENTS	SPECIALIZED RETAIL ESTABLISHMENTS
AVERAGE PROPORTION	20.38%	79.62%
MINIMUM	0.00%	44.83%
MAXIMUM	55.17%	100.00%
MEDIAN	19.64	80.36
QUARTILE 1 (25%)	14.63	75.00
QUARTILE 3 (75%)	25.00	85.37

Table 10. Descriptive Statistics – Proportion of convenience and specialized retail establishments per commercial street.
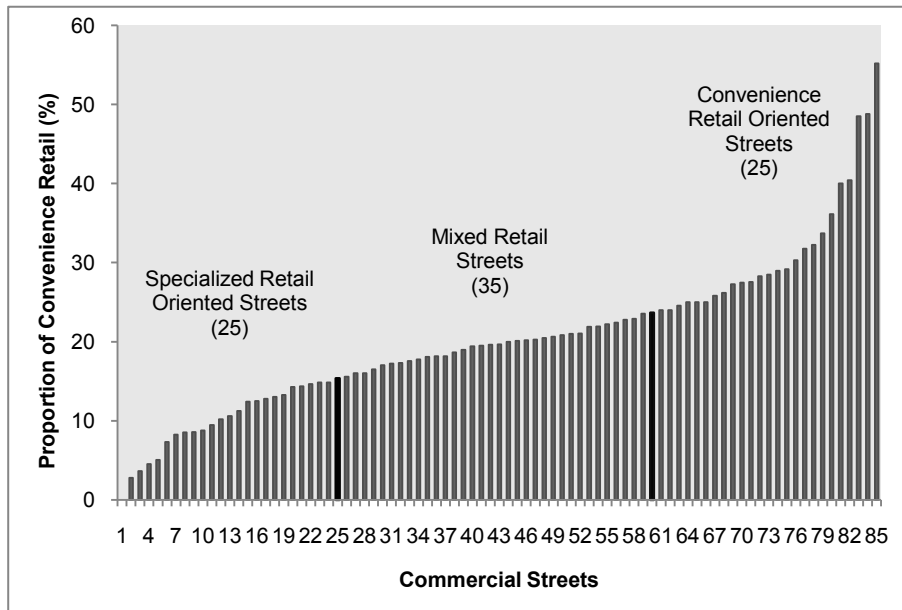
Figure 22. Commercial Streets Grouped by Proportion of Convenience Retail.
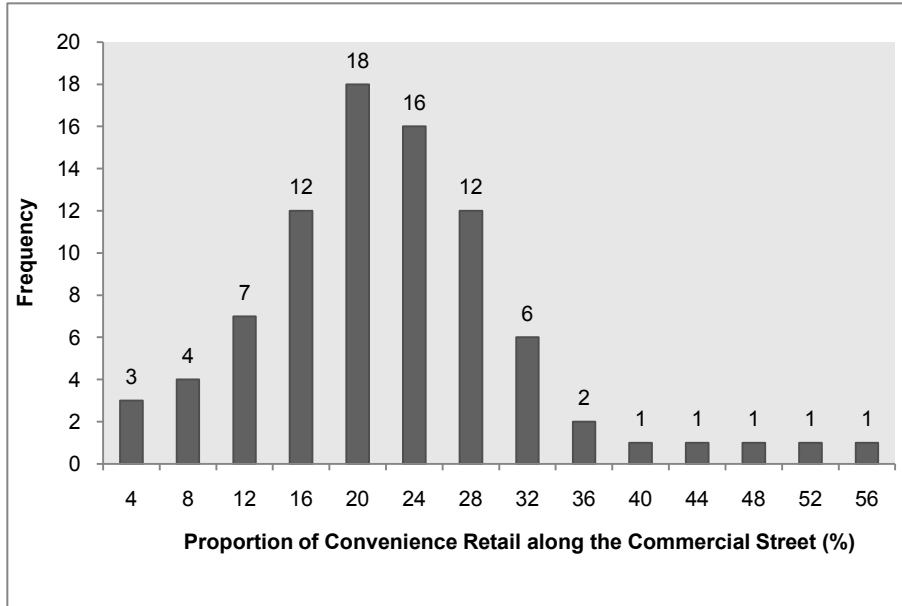
Figure 23. Frequency Histogram – Proportion of Convenience Retail Establishments.

Average Retail Density

The purpose of this second "global" analysis is to provide a general picture of the intensity of retail activities along Montréal's commercial arteries and characterize these streets according to their level of retail density.

Methodology

As part of this analysis, the average retail density was calculated for each commercial street by dividing the total length of the commercial street by the total number of commercial establishments present along the street. This ratio was then multiplied by 100 to provide an idea of the average number of commercial establishments per 100 meters along the street, regardless of the length. This

measure assumes that commercial activities are evenly distribution along the entire street, and only allows for initial street comparisons.

Prior to the examination of the street retail density, basic statistics were produced regarding the length and the number of commercial establishments present along the street.

Analysis

- Commercial Streets Length

As previously mentioned in the methodology section, the sample of commercial streets was selected based on the City of Montreal's database, Sherlock, which defines a commercial artery as "a concentration of a minimum of 50 commercial establishments located on a section of a Montreal's street. In general, this section is no longer than 1 km in length".

However, a significant level of variation was observed within our sample since the length of a commercial street varies from 172.67 meters (Rue de la Montagne) to 3,970 meters (Rue Sherbrooke Est, RDP) (Table 11). It is therefore difficult to identify a certain pattern among the set of commercial arteries.

That being said, looking at the frequency distribution of the length of the 85 commercial streets using bin intervals of 250 meters (Fig. 25), it can be easily observed that the majority of commercial streets (45 streets, i.e. 53%) are shorter than 1km. On the other hand, it can be inferred that about 40 commercial streets do not fit into the conventional definition used by the City of Montréal.

Discussion

The length of a commercial street is a key variable to consider in this analysis as the purpose is to understand whether commercial establishments are evenly distributed along the street, or whether there exists some concentrations of commercial activities along a limited number of street segments. As a consequence, a difference is to be made between a street zoned as commercial and the actual street segments that are dedicated to commercial and service activities. This justifies the decision to undertake an analogous analysis on a finer scale, looking at the spatial distribution of commercial segments per street segment.

AVERAGE LENGTH (in meters)	1188.39
MINIMUM LENGTH (in meters)	172.67
MAXIMUM LENGTH (in meters)	3970.40
MEDIAN	936.28

Table 11. Descriptive Statistics – Commercial Streets Length.
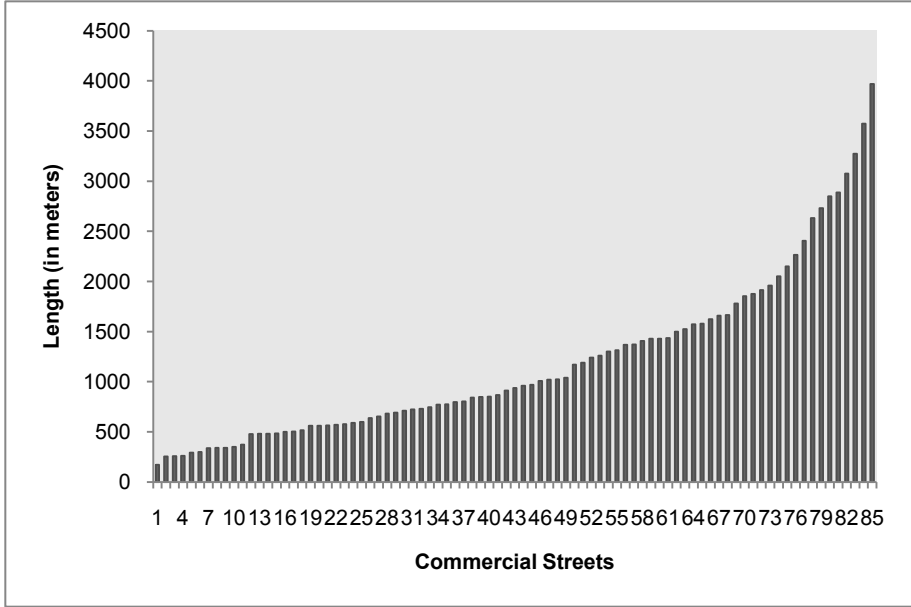
Figure 24. Commercial Streets grouped by Length.
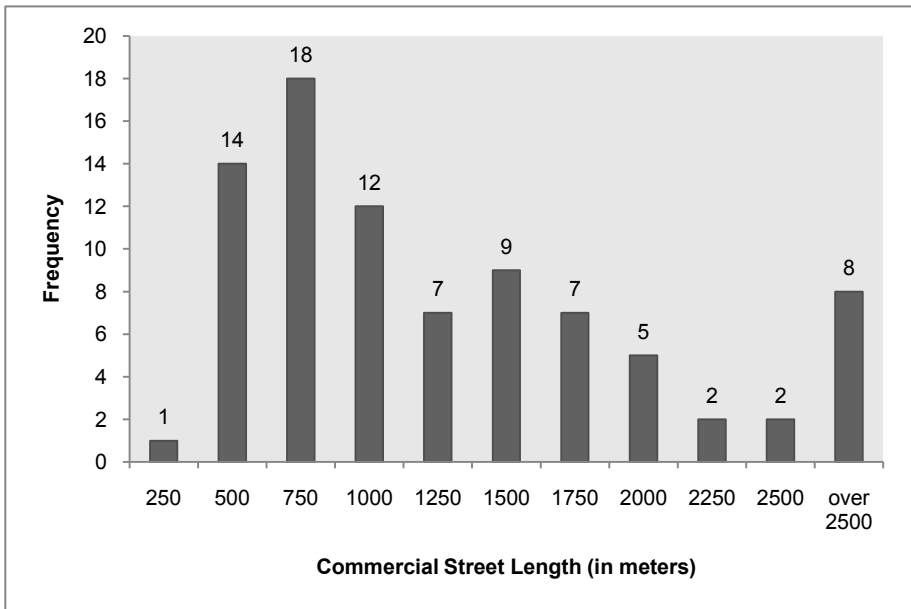
Figure 25. Frequency Histogram – Commercial Streets Length.

- Number of Commercial Establishments

The second analysis focuses on the number of commercial establishments present along the street. In accordance with the length analysis, significant discrepancies are observed among the sample of commercial streets.

According to the City of Montréal's definition, a commercial street has a minimum of 50 commercial establishments. However, it can be observed that 20 streets, i.e. 24% of the sample, have less than 50 commercial establishments. The number of businesses present along the street ranges from 22 (Rue Prince Arthur, PMR) to 635 (Rue Sherbrooke West, VM), with an average of 132 commercial establishments, 24 being oriented towards convenience retail and 108 towards specialized retail. Finally, 50% of the commercial streets have less than 98 commercial establishments (Table 12). .

Discussion

Looking at the number of commercial establishments per commercial street allows for outliers us to be detected. These correspond to three "inner-city shopping malls":

- *Plaza Côte des Neiges*, Chemin de la Côte des Neiges (CDN-NDG): 545 commercial establishments

- *Place Versailles*, Rue Sherbrooke Est (from Viau to Autoroute 25, MHM): 428 commercial establishments

- *Place Dupuis*, Rue Ste Catherine East (from St Hubert to De Lorimier, VM): 190 commercial establishments

These inner-city shopping malls were included in the first set of global analyses. However, they will be given a particular attention in the second-tier analysis as their impact is even more significant when looking at the spatial distribution of commercial establishments per street segment.

	Total Number of Commercial Establishments per street	Number of Convenience Retail Establishments	Number of Specialized Retail Establishments
AVERAGE	132	24	108
MINIMUM	22	0	13
MAXIMUM	614	103	549
MEDIAN	98	17	78

Table 12. Descriptive Statistics – Number of Commercial Establishments per commercial street.
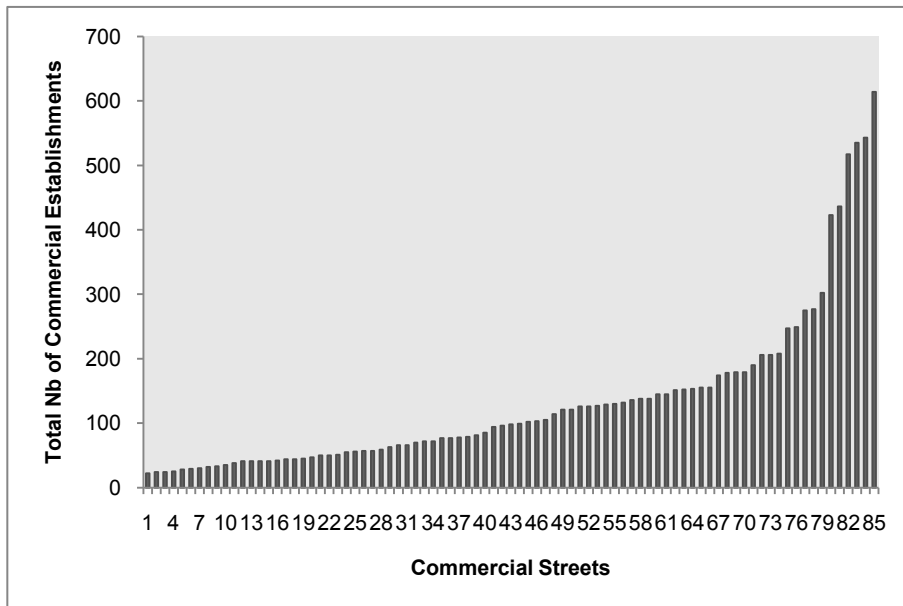
Figure 26. Commercial Streets grouped by Number of Commercial Establishments
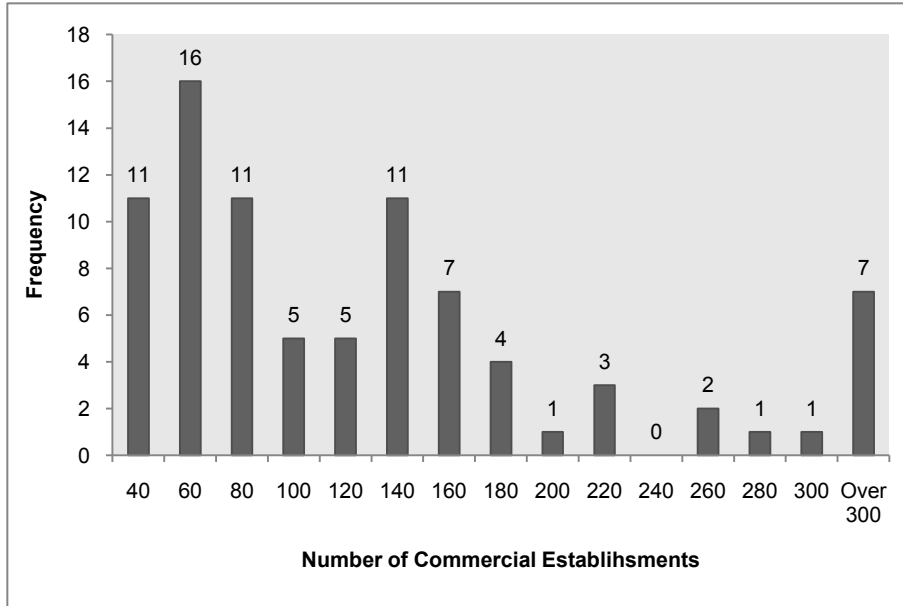
Figure 27. Frequency Histogram – Number of Commercial Establishments per Commercial Street

- Retail Density Analysis

The third part of this analysis consists in a study of the average retail density along commercial streets through a combination of the two previous analyses. This seeks to provide a general picture of the intensity of commercial activities in the Montreal's retail landscape.

85 retail density values were calculated for each commercial street of the sample and then mapped with ArcGIS®. As explained earlier, the density gives an indication of the average number of commercial establishments per 100 meters along the street. Therefore, this measure disregards the variations in terms of localization and spatial distribution of commercial activities along the street.

Looking at the frequency histogram (Fig. 30), a great majority (65 streets, or 76%) of commercial streets has an average retail density ranging from 3 to 15 commercial establishments per 100 meters; and 50% of the commercial streets have more than 9 commercial establishments per 100 meters. On average and regardless of their length, commercial streets have about 12 commercial establishments per 100 meters (Table 14).

Classification

The last step of this analysis consists in building a classification of commercial streets based on their level of retail density. In order to do so, the natural breaks method of classification was employed. This method, proposed and available in ArcGIS®, is designed to determine the best arrangement of values into different classes. This method also seeks to minimize each class' average deviation from the class mean, and maximizing each class' description from the mean of other groups. In other words, it seeks to reduce the variance within class and maximize the variance among class. This method was chosen because of the great level of dispersion among the data. Therefore, it seems to be the most appropriate method to arrange the values at their best and provide an accurate picture of the intensity of retail activities in the Montréal's landscape. Commercial streets were classified into three categories according to their level of retail density.

CATEGORY	Retail Density per Commercial Street	Frequency - Number of Commercial Streets
HIGHER RETAIL DENSITY	19.472 – 33.038	12
INTERMEDIATE RETAIL DENSITY	7.836 – 19.471	43
LOWER RETAIL DENSITY	3.661 – 7.835	30

Table 13. Classification of commercial streets based on their level of Retail Density
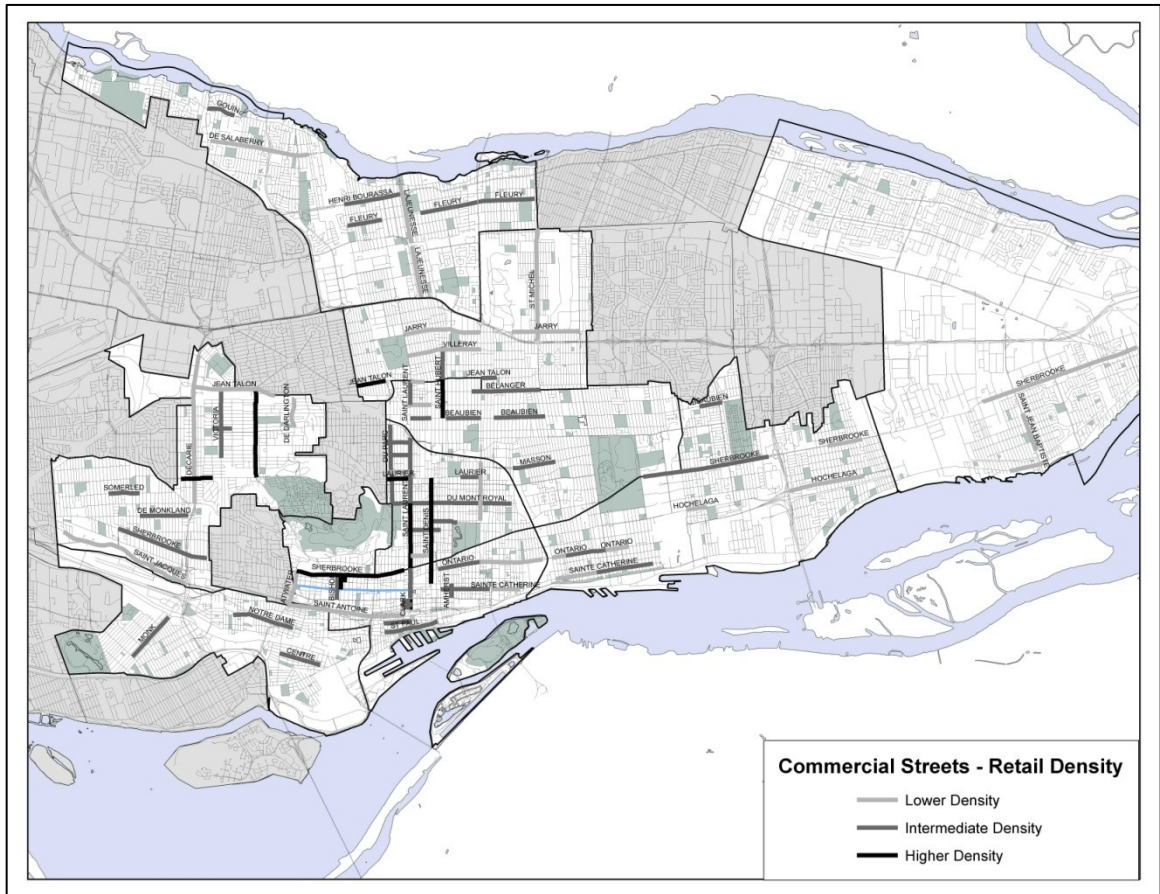
Figure 28. Montréal's Commercial Streets categorized by Retail Density

AVERAGE DENSITY	11.827
MINIMUM DENSITY	3.661
MAXIMUM DENSITY	33.038
MEDIAN	9.324

Table 14. Descriptive Statistics – Commercial Street Retail Density
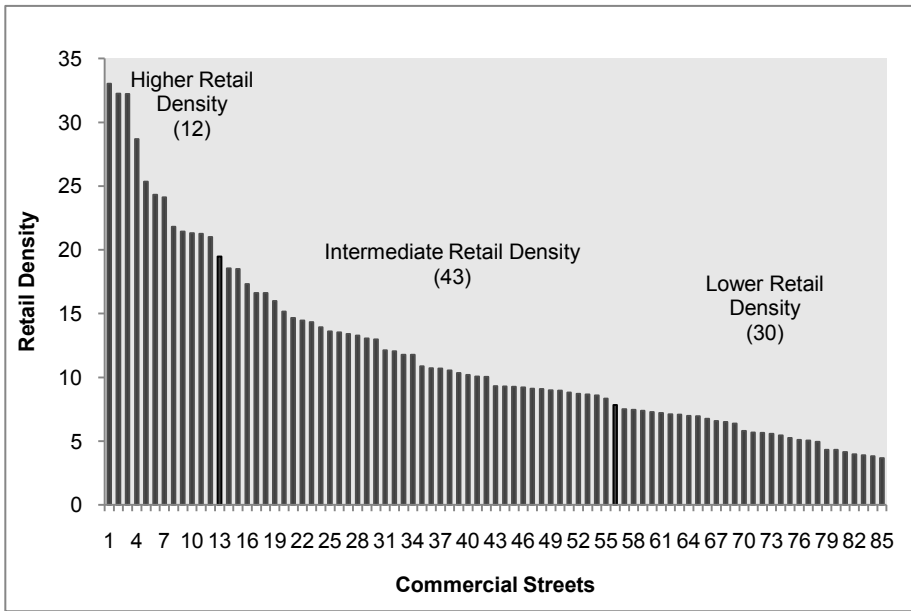
Figure 29. Commercial Streets grouped by Level of Retail Density
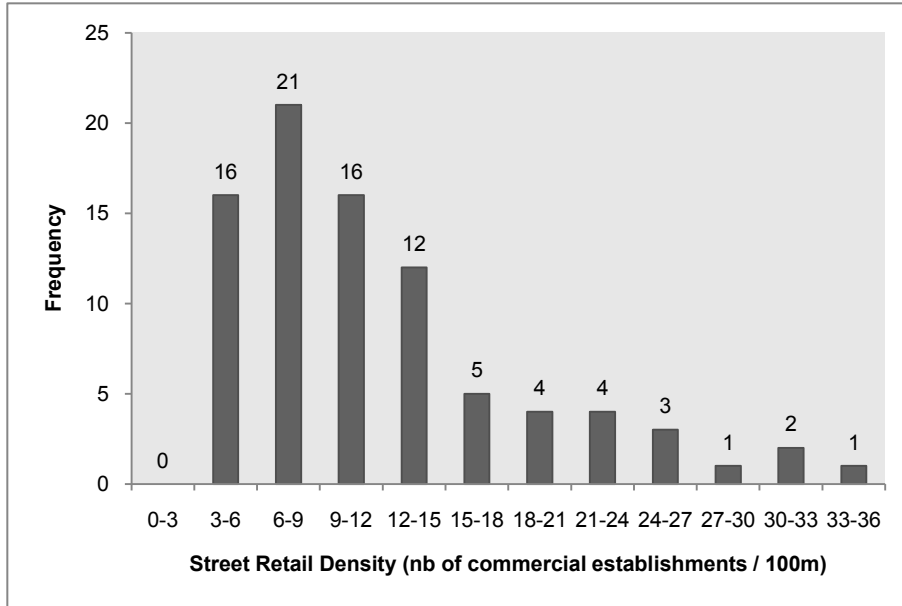
Figure 30. Frequency Histogram – Commercial Street Retail Density

Discussion

While taking into account the several limitations mentioned above, this first set of classifications provides a general picture of the distribution of retail activities along commercial streets in Montréal, and allows for differentiating streets according to their dominant category of retail offering. Performed at a global level, this analysis includes all streets, regardless of the number of commercial establishments and length. Also, it allows for the identification of outliers within the dataset, which will be excluded in the second-tier analysis. Although the City of Montréal has established criteria for defining "commercial artery", the 85 commercial streets selected for this study vary a lot in terms of length and total number of commercial establishments. These observations provides an important basis for further comparison with the second-tier analysis and justify

the need to look at the distribution pattern of services and amenities on a finer scale, namely per street segment. This complementary analysis seeks to determine with more accuracy the impact of spatial determinants on the spatial distribution of retail activities by detecting the presence of local variations and concentrations of retail within the commercial street.

MORPHOLOGICAL CHARACTERIZATION

This research investigates both commercial and spatial characteristics of commercial streets. The morphological characterization is performed through the quantification and qualification of two physical elements of the urban tissue:

- The level of permeability of the commercial street;

- The relative position, or the level of centrality, of the commercial street within a morphological unit.

Street Permeability

One objective of this research is to verify whether a relationship exists between the level of permeability of a commercial and the predominant nature of commercial offer. More specifically, it is assumed that higher level of permeability would be associated with a higher prevalence of convenience retail.

For the purpose of this analysis, street permeability was measured as the average distance between intersections on both sides of the commercial street. In order to account for the different types of intersections on the street, mainly T-

types and X-types, the distance between intersections were measured for both sides of the street and an average was produced.

A permeability "index" was then assigned to each commercial street. Once again, the entire street is given one unique value of permeability, which does not allow for spatial and morphological variations along the street to be captured.

Montréal's commercial arteries have a street permeability ranging from 59.57 meters (Rue Prince Arthur, PMR) to 413.55 meters (Rue St Jacques, CDN-NDG) (Table 16). However, looking at the frequency histogram (Fig. 33), a great majority of commercial streets have an average distance between intersections ranging from 50 to 150 meters. In fact, 50% of the commercial streets have a level of street permeability below 105.33 meters, and by extension, 75% of the street sample feature a permeability level inferior to 150 meters (Table 16).

As for the commercial characterization, the purpose is to organize commercial streets into categories according to their level of permeability. The measurements done to assess street permeability were divided into three categories using the natural break method of classification.

- *Streets with higher level of permeability*: The largest category in our sample as it comprises 42 commercial streets. These have an average distance between intersections ranging from 59.57 to 98.92 meters, for a combined average distance of 81.87 meters between intersections.

- ***Streets with intermediate level of permeability***: This category includes 32 commercial streets with a permeability level ranging from 105.33 to 230.78 meters, for a combined average of 142.92 meters.

- ***Streets with lower level of permeability***: The smallest category in the sample as it includes 11 commercial streets only. These streets have an average of 293.35 meters between intersections, with average distances ranging from 230.79 to 413.45 meters.

LEVEL OF PERMEABILTY	STREET PERMEABILITY (in meters)	FREQUENCY - Number of Commercial Streets
HIGHER PERMEABILITY	59.57 – 105.32	42
INTERMEDIATE PERMEABILITY	105.33 – 230.78	32
LOWER PERMEABILITY	230.79 – 413.45	11

Table 15. Classification of commercial streets based on the level of Permeability

Figure 31. Montréal's Commercial Streets categorized by level of Permeability

AVERAGE (in meters)	132.22
MINIMUM (in meters)	59.57
MAXIMUM (in meters)	413.45
MEDIAN (in meters)	105.33
QUARTILE 1 (in meters)	83.21
QUARTILE 3 (in meters)	149.31

Table 16. Descriptive Statistics – Street Permeability
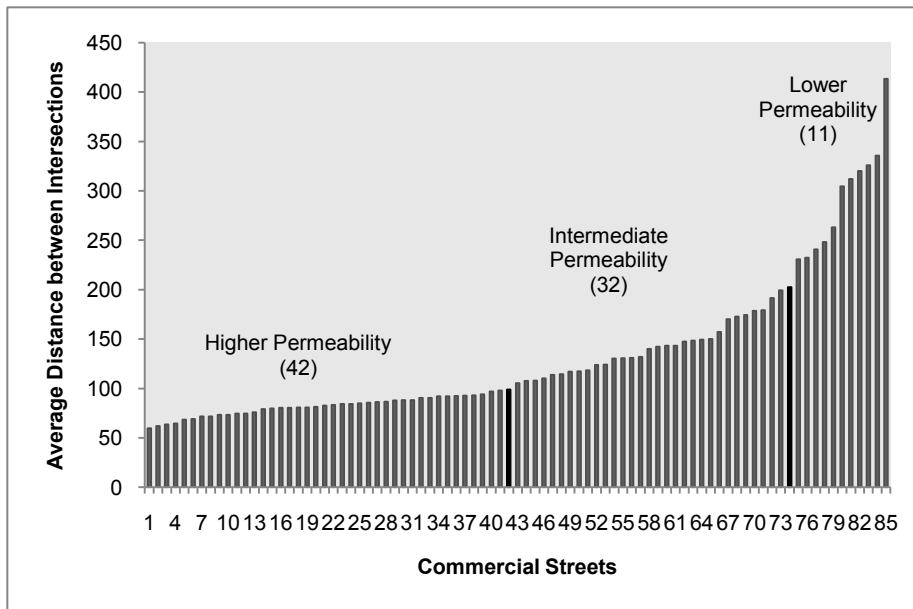
Figure 32. Commercial Streets grouped by level of Permeability
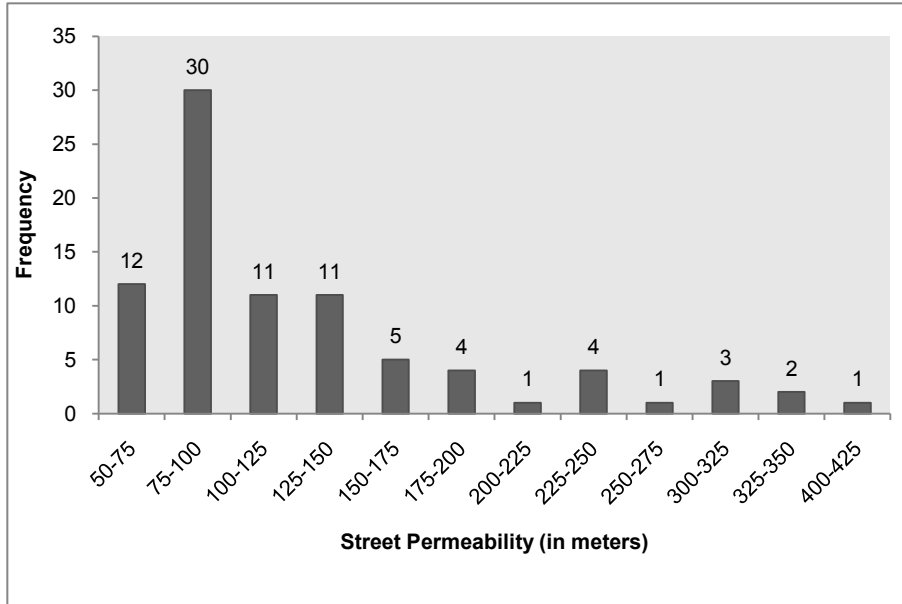
Figure 33. Frequency Histogram – Street Permeability

Discussion

Various measures of street connectivity or permeability were developed in the literature. Within the framework of this research, the permeability of a commercial street was measured by looking at the average distance between intersections along the street segments zoned as commercial. This method only allows us to determine the level of permeability of the commercial streets included in the sample, and compare them with each other. This implies that commercial and ordinary streets can't be compared based on their level of permeability and, it can't be ascertained that, as stated by the central place theory, commercial streets feature higher levels of connectivity than ordinary streets (Hillier, 1996). This method also disregards the presence of physical barriers or major

intersections that could eventually affect the street permeability when the whole street network is considered.

Despite these limitations, measuring the permeability of commercial streets by taking the average distance between intersections remains a relevant indication for examining the Montréal's urban context, where a grid street pattern prevails. This urban structure results from the establishment of the "long lot" land system under the seigneurial system of New France. The permeability analysis confirms the idea according to which commercial streets were planned and developed along "le petit côté de l'ilôt", or the narrow side of the block.

Finally, a similar analysis will be carried out on a finer scale, namely measuring the level of permeability of sequence of street segments along which retail activities, and more particularly convenience stores, are clustered. This analysis still attempts to explore the relationship between the level of permeability and the predominant category of commercial offer.

Relative Position

For the purpose of this study, the relative position of a commercial street within an urban area is the second spatial attribute to be examined. This analysis seeks to ascertain whether centrally located commercial streets are predominantly oriented towards convenience retail, while peripherally located arteries are most likely to favor specialized retail activities.

Based on central place theory, the underlying assumption is that centrally located commercial streets serve a local catchment area, such as a neighborhood, and

provide residents with lower order of goods and services, i.e. convenience retail. Also, a central location is often associated with higher levels of permeability (or connectivity), encouraging pedestrian activity for local shopping trips.

In contrast, the provision of comparison or specialty goods usually relies on a larger catchment area. Therefore, specialized retail oriented streets would favor a peripheral position, either at major transportation foci (close to major roads or thoroughfares), or at the frontier of two urban areas so as to enhance accessibility and serve a wider clientele that is more willing to drive to make specific purchases.

Morphological urban areas are spatially delineated by the presence of physical barriers, which can either be natural (river, hill, escarpments, etc…) or artificial (railway, highway, major roads and thoroughfares, etc…) (MacDougall, Forthcoming). These morphological units served as the framework for determining the level of centrality, or peripherality, of each commercial street.

A GIS map including all major roads and highways, rail, main railway, transit lines, sidetrack, and abandoned rail lines, as well as parks and other recreation spaces present on the Montréal island was produced. The relative position of a commercial street was then visually assessed through cartographic evidence by examining the centrality of its position within a morphological area, namely the proximity to the geographical centre of the morphological area and the relative distance to the edge, namely physical barriers.

Based on this cartographic assessment, 52 commercial streets were labeled as "centrally located" and 33 as "peripherally located". Within the sample, major arteries such as Boulevard St Laurent and Avenue du Parc, etc. were considered as thoroughfares and hence labeled as "peripheral".
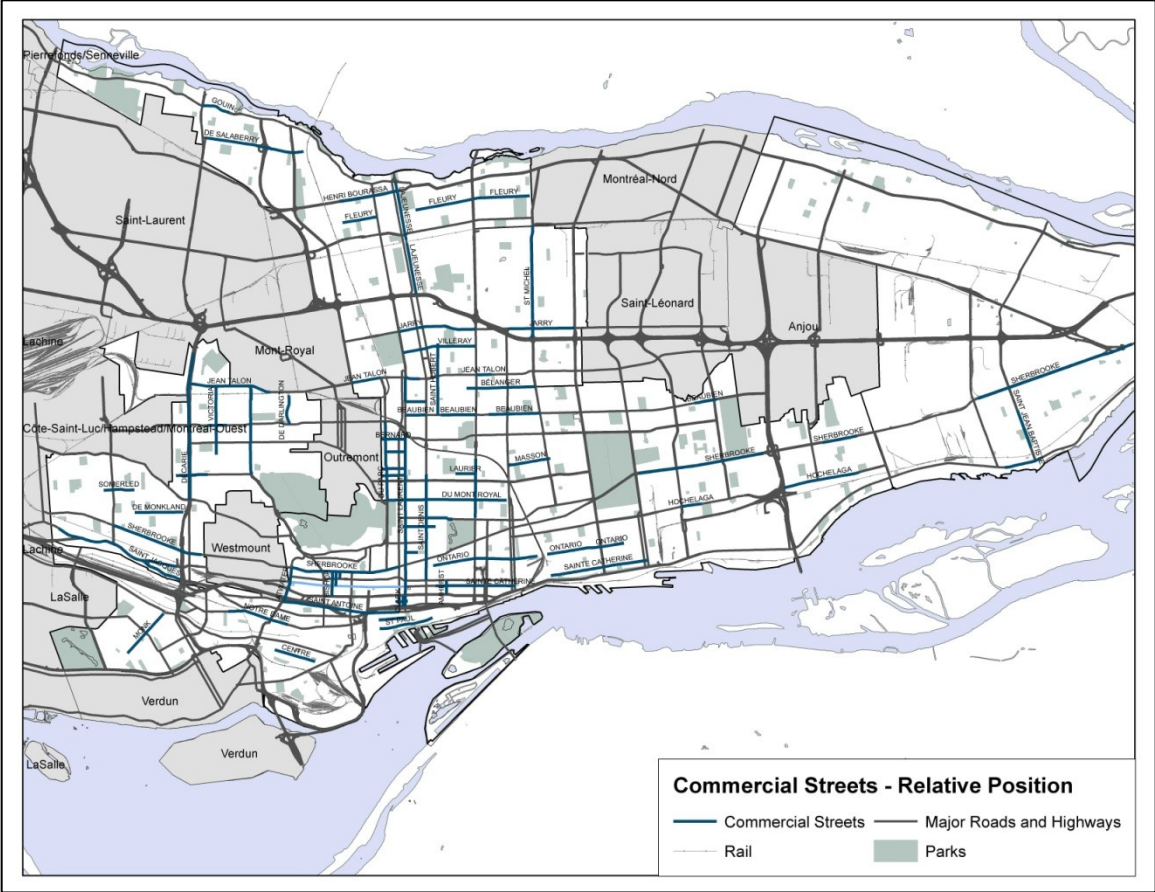
Figure 34. Relative Position of Montréal's Commercial Streets
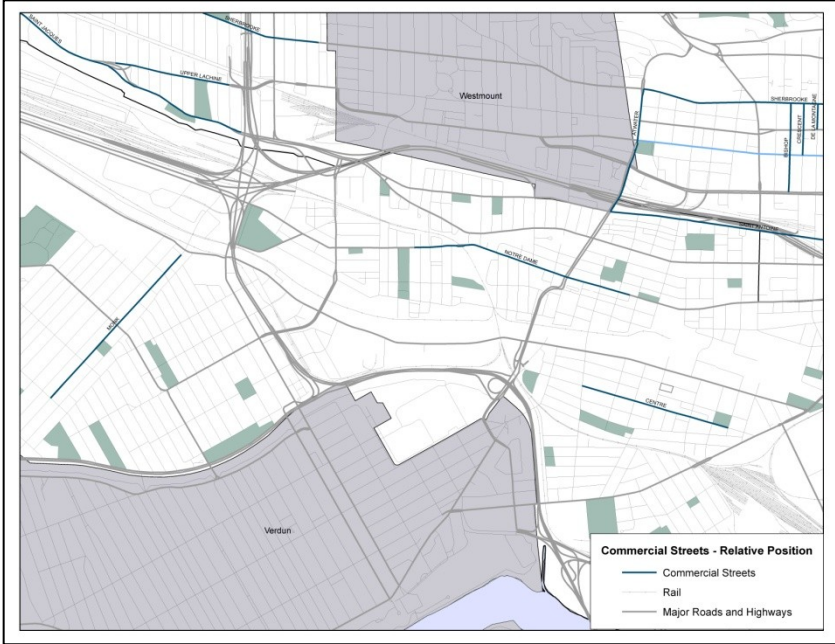
Figure 35. Relative Position of Commercial Streets, Sud Ouest.

Figure 36. Relative Position of Commercial Streets, Rosemont Petite Patrie.
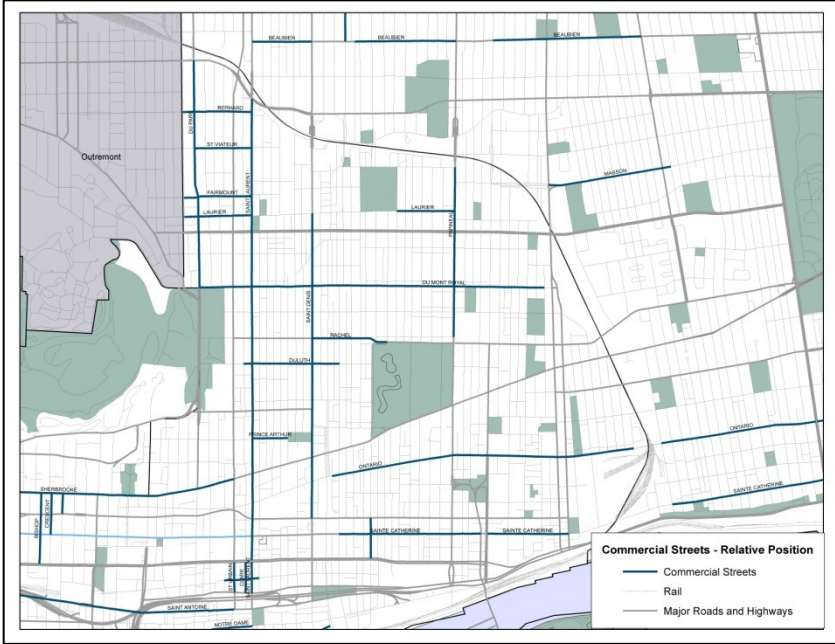
Figure 37. Relative Position of Commercial Streets, Plateau Mont Royal and Ville Marie.

CROSS-ANALYSIS OF GLOBAL CHARACTERISTICS

Montréal's commercial streets were characterized and categorized according to specific commercial and morphological attributes. The resulted classifications were cross-examined to evaluate the impact of spatial determinants on the nature of retail offering. This part of the analysis seeks to verify whether a relationship exists between the predominant nature of commercial offer and (1) the street permeability as well as (2) the relative position of the commercial street.

Relationship between the Commercial Offer and the level of Permeability

This analysis investigates the relationship between the level of street permeability and the predominant nature of commercial offer by cross-examining the categories of commercial streets described in the previous section. The results suggest that the higher the permeability, the more likely convenience retail activities would prevail along the commercial artery.

By combining categories of commercial streets based on retail profile and street permeability, the results reveal that the majority of convenience retail oriented streets (68%) and mixed retail streets (57%) feature higher level of permeability (Fig. 39).

In addition, mixed and convenience retail oriented streets are predominant within the "higher permeability" street category. Only five specialized retail oriented streets feature such permeability level (Fig. 38). As a consequence, these preliminary results indicate that streets with higher level of permeability would favor primarily convenience, and by extension mixed, retail activities.

In contrast, the interpretation of the results is limited when examining the relationship between lower level of permeability and specialized retail. Most specialized retail oriented streets are characterized by an "intermediate" level of permeability. Also, there is an equal number of convenience and specialized retail oriented streets featuring lower permeability (Fig. 38).

Therefore, as the results suggest that convenience retail activities would most likely be located along highly permeable commercial streets, no such relationship can be established for the specialized retail category, also meaning that the location of higher order goods and services is less dependent upon permeability levels.

	CONVENIENCE RETAIL	MIXED RETAIL	SPECIALIZED RETAIL	TOTAL
LOWER PERMEABILITY	3	5	3	11
INTERMEDIATE PERMEABILITY	5	10	17	32
HIGHER PERMEABILITY	17	20	5	42
TOTAL	25	35	25	85

Table 17. Cross-Tabulation: Commercial Offer and Street Permeability.

Figure 38. Frequency of commercial streets by level of permeability according to commercial offer.
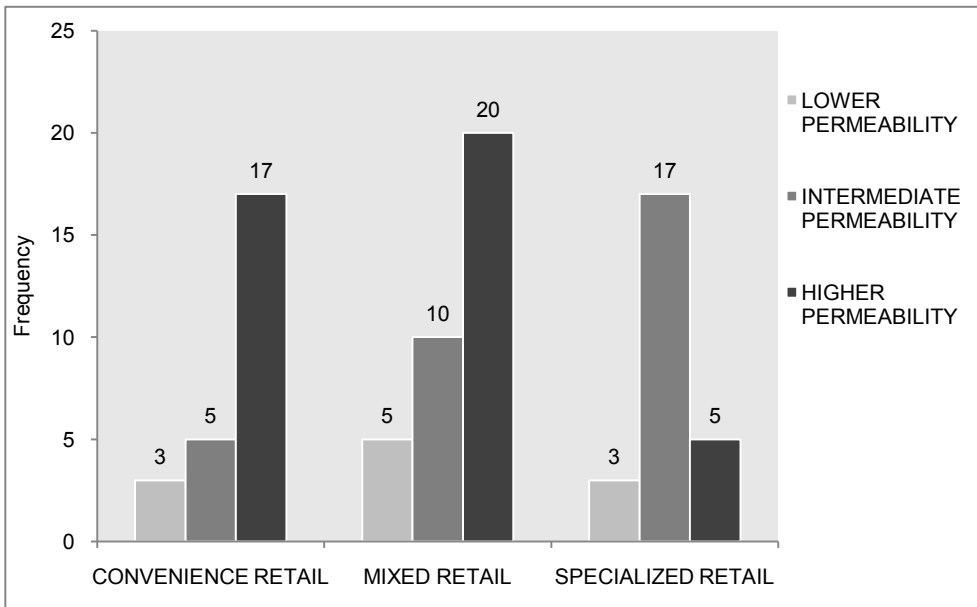
Figure 39. Frequency of commercial streets by categories of commercial offer according to level of permeability.

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Relationship between the Commercial Offer and the Relative Position

A similar analysis is undertaken to investigate the relationship between the relative position of a commercial street within the morphological unit and the predominant nature of commercial activities.

Within the framework of this research, centrally located streets within the morphological unit are presumed to favor convenience retail activities, while peripheral streets would serve destination retail primarily. The results indicate that, to a certain extent, such a relationship can be observed.

Although the sample contains 85 commercial streets with diverse "personalities" and spatial environments, this second test was limited given the higher number of streets labeled as "centrally located" (52), compared to the ones labeled as "peripherally located" (33).

The results suggest that when centrally located, commercial streets primarily favor mixed and convenience retail activities. Indeed, a majority of convenience and mixed retail streets are located in a central position (Fig. 40). Besides, among the convenience retail streets category, 18 out of the 25 commercial streets are also located in a central position (Fig. 41). Only 7 convenience retail commercial streets are hence peripherally located. With regard to mixed retail streets, there are also a higher number of centrally located streets (22) than peripherally located ones (13) (Fig. 41). At total, 77% of the commercial streets featuring a central position are characterized by either mixed (42%) or convenience (35%) retail activities (Fig. 40). Therefore, these results suggest that

commercial streets providing convenience goods and services are more likely to be centrally located within the morphological unit.

In contrast, no such association can be observed between the relative position of a commercial street and the predominance of specialized retail establishments. In fact, within the category of specialized retail oriented streets, there is almost an equal number of centrally (12) and peripherally (13) located streets (Fig. 41).

	CONVENIENCE RETAIL STREETS	MIXED RETAIL STREETS	SPECIALIZED RETAIL STREETS	TOTAL
CENTRAL POSITION	18	22	12	52
PERIPHERAL POSITION	7	13	13	33
TOTAL	25	35	25	85

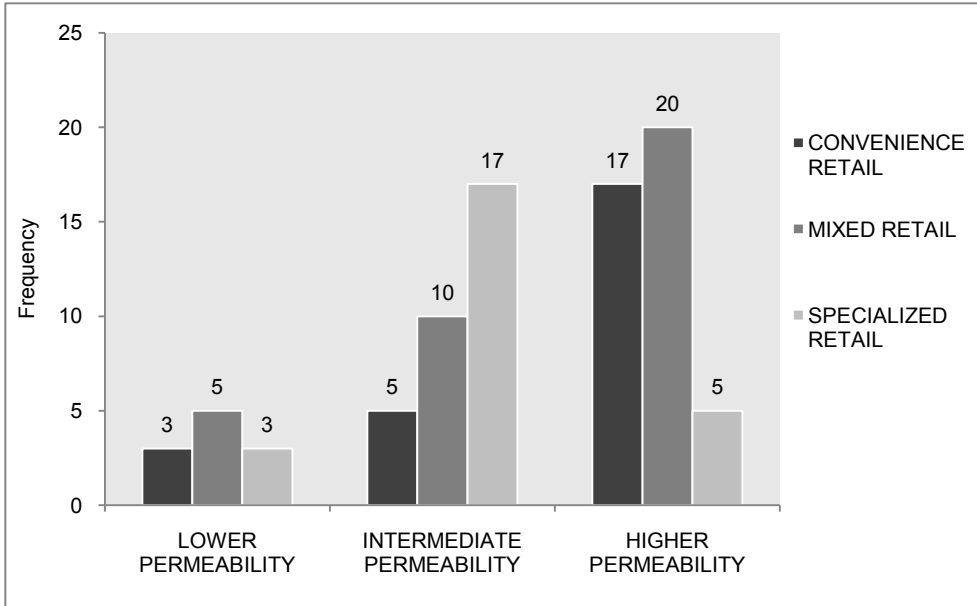**Table 18**. Cross-Tabulation: Commercial Offer and Relative Position
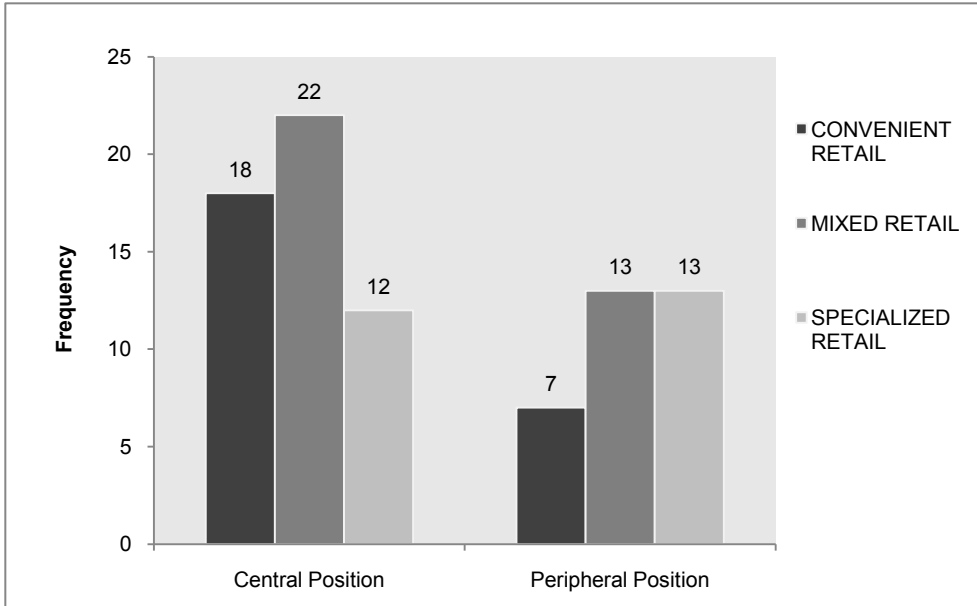
Figure 40. Frequency of commercial streets by relative position according to commercial offer.
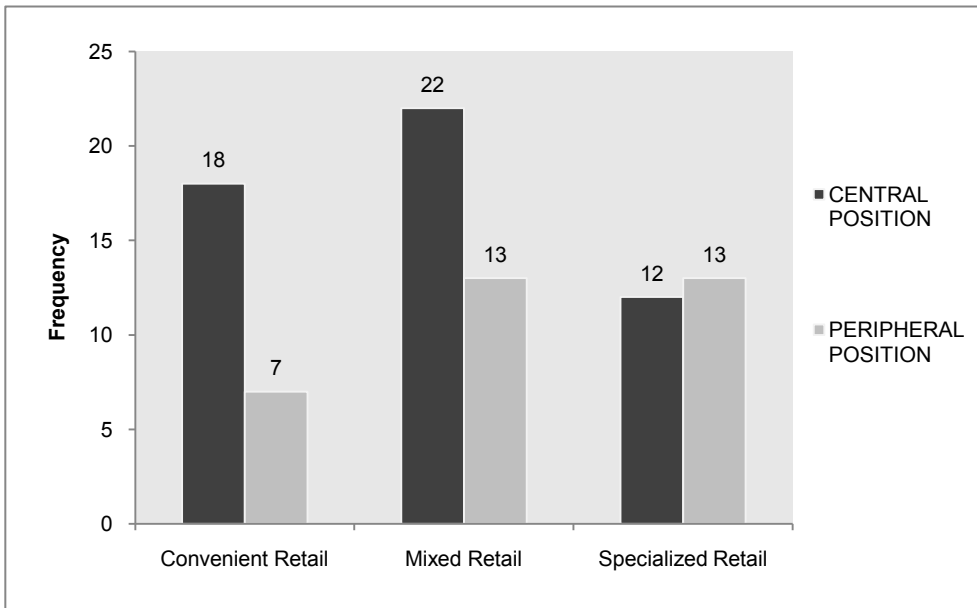
Figure 41. Frequency of commercial streets by commercial offer according to relative position.

The results of this analysis indicate that a relationship between urban form and retail offer can be observed. Yet, further analyses are to be conducted.

First, to a certain extent, the results reaffirm the existence of the relationship asserted by the central place theory between retail location and retail activity. Within the framework of this analysis, the results reveal that convenience retail oriented streets are primarily centrally located. In contrast, specialized retail activities are equally distributed between commercial streets that are centrally and peripherally located.

Second, the results suggest that streets with higher level of permeability favor both convenience and mixed retail activities, while specialized retail would be less dependent upon permeability. Therefore, based again on central place theory, accessibility seems to matter more than permeability to predict where goods and services of a higher order would be located.

CHAPTER 4-2. ANALYSIS OF COMMERCIAL STREETS AT THE LOCAL LEVEL

INTRODUCTION

This research consists in a two-pronged analysis. As a first stage, commercial streets were characterized according to commercial (retail profile) and morphological (permeability and centrality) attributes. This first analysis provided a general picture of the retail activities found along 85 commercial streets in Montreal, while allowing for basic but essential comparisons among these arteries, as described in the previous sections.

However, this analysis disregards the local variations and particularities in the spatial distribution of commercial activities that can be revealed when performing a similar analysis on a finer scale, i.e. focusing on internal street segments.

Consequently, the second-tier analysis seeks to examine with more accuracy the impact of the urban form on the location and distribution of commercial activities by capturing the presence of clusters and concentrations of retail along the commercial artery. Again, the purpose is to examine the impact of some spatial determinants pertaining to the level of permeability and the relative position on the distribution of commercial establishments within the commercial street. By performing a street-segment based analysis, the intent is to highlight the

presence of different retail profiles along the street according to the segments considered, and reveal a certain consistency in the spatial distribution pattern of retail activities at the local level. As a reminder, it is assumed that, especially for long commercial streets, commercial establishments are not evenly distributed along a street zoned as commercial, implying that some segments would be characterized by higher level of retail density. Also, the relationship between the level of permeability and the presence of convenience stores is now explored at the local level, supposing that concentrations of convenience retail would be located along highly permeable street segments, whereas low permeable sections would be more amenable to specialized retail.

Finally, the "local analysis" considers the presence of parks, attractors and metro stations along the street as these three spatial elements may have an impact on convenience retail spatial distribution.

METHODOLOGY

In terms of methodology, as the retail density was calculated per commercial street in the previous section, a similar density index is now computed per street segment. The general formula is described as follows:

(Total number of commercial establishments along the street segment / Street Segment Length) * 100.

This calculation was repeated three times:

- Average retail density per street segment (both categories of commercial establishments)

- Average convenience retail density per street segment

- Average specialized retail density per street segment

These ratios allow for comparisons between street segments, regardless of their length. For the purpose of this research, these density values were displayed on a map using ArcGIS®, providing a clearer picture of where and how the different categories of commercial establishments are spatially distributed along the artery. This also allows us to detect the presence of clusters, and differentiate streets according to their spatial configuration, or "commercial sequence".

The three data distributions combine a high number of 0 values, corresponding to the street segments with no commercial establishments, and the presence of outliers such as the three "inner-city shopping malls" mentioned earlier. The proportion of 0 values is particularly significant when calculating the convenience retail density per street segment.

Average Retail Density per Street Segment

The first data distribution describes the average retail density on a street-segment basis. As explained, the total number of commercial establishments along a street segment is divided by the street segment length, and then multiplied by 100.

The 85 commercial streets of the sample were divided into 1,193 street segments in ArcGIS®. Consequently, a total of 1,193 density values were computed.

First of all, there are a certain number of street segments along which there are no commercial establishments. Within the first data distribution, these 180 street segments have a density value equals to 0 (n=180). In addition, this data distribution is biased by the presence of inner city shopping malls. In fact, the maximum value of "169.01" means that along this street segment, there are 169 commercial establishments per 100 meters. This actually corresponds to the shopping mall located along Sherbrooke Street (MHM), *Place Versailles*. For the purpose of this local analysis, the three shopping malls were singled out and excluded from the rest of the data distribution. In addition, using the histogram tool for exploring spatial data distribution in ArcGIS®, 17 additional outliers were identified.

A set of descriptive statistics was produced for analyzing this first data distribution (Table 19). On average, a street segment has 10.92 commercial establishments per 100 meters. Also, 50% of the street segments considered in the sample have less than 8.63 commercial establishments per 100 meters.

	Entire Dataset n=1,193	Null Values and Outliers excluded n=993
Minimum	0.00 (n=180)	0.39
Maximum	169.01	49.69
Mean	10.35	10.92
Median	7.13	8.63
Standard Deviation	12.84	8.89

Table 19. Descriptive Statistics – Retail Density per Street Segment

Classification

Once null values and outliers were excluded from the dataset, retail density values were divided into five categories using the natural breaks method of classification (Table 20). Then, a cartographic representation of the average retail density was produced (Fig. 42 and 43).

LABEL	Range	Frequency
Null Values	0.00	180
"Lower Density"	0.01 – 6.13	357
	6.14 – 12.19	307
"Intermediate Density"	12.20 – 20.03	191
"Higher Density"	20.04 – 31.16	101
	31.17 – 49.69	37
Outliers	49.70 – 169.01	20

Table 20. Classification – Retail Density per Street Segment

Figure 42. Map of Montréal's commercial arteries displaying the density of retail activities per street segment (RPP and VMPE).
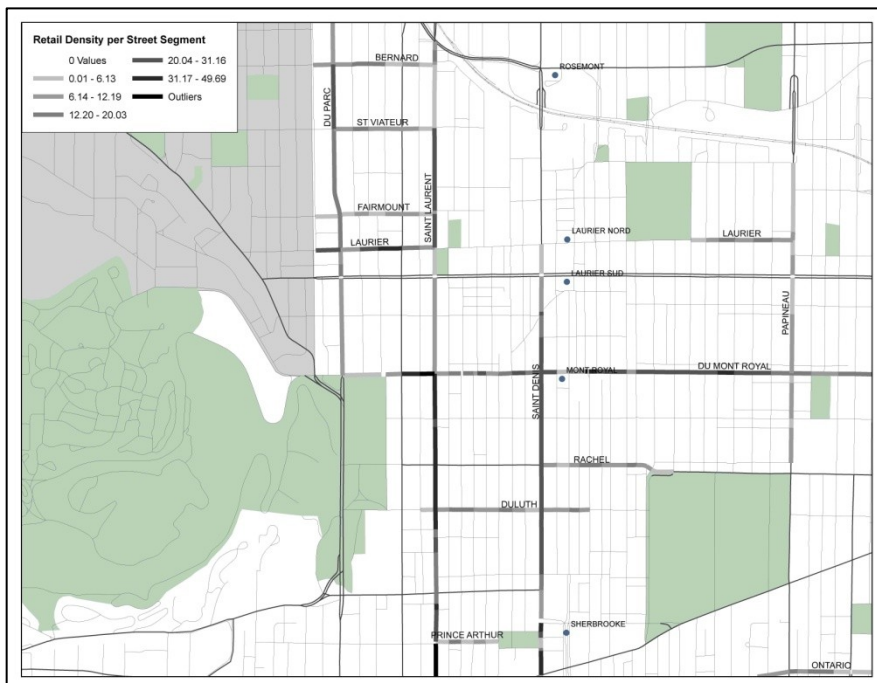
Figure 43. Map of Montréal's commercial arteries displaying the density of retail activities per street segment (Plateau and Mile End).

Convenience Retail Density per street segment

The second data distribution concerns the convenience retail density per street segment. The total number of convenience stores present along a street segment is divided by the street segment length, and then multiplied by 100.

Because convenience stores account for only 18% of the total number of commercial establishments in the REEM census, a very high number of street segments do not have convenience stores. Therefore, when the 1,193 convenience retail density values were computed, almost 38% of the dataset were associated with a null value (n=453).

In addition, the presence of inner-city shopping malls has again a strong impact on the data distribution. The maximum density value of 25.22 convenience stores per street segment of 100 meters corresponds again to *Place Versailles*, along Sherbrooke East (MHM). In fact, only three street segments have a convenience retail density above 17 commercial establishments per 100 meters, corresponding to the three inner-city shopping malls mentioned previously. Exploring the data distribution using the histogram tool in ArcGIS®, eight additional outliers were identified. In total, 11 outliers were singled out and hence excluded from this analysis.

Along Montreal's traditional commercial arteries, there is on average almost 3 convenience stores per segment of 100 meters. Besides, 50% of the street segments of the sample have less than 2.38 convenience stores per 100 meters (Table 21).

	Entire Dataset N= 1,193	Null Values Excluded, Outliers Excluded N=729
Minimum	0.00 (n=453. i.e. 37.97%)	0.36
Maximum	25.22	9.96
Mean	1.93	2.93
Median	1.30	2.38
Standard Deviation	2.51	1.97

Table 21. Descriptive Statistics – Convenience Retail Density per Street Segment

Classification

An analogous method of classification was used to allow for cartographic representation of the data distribution: Both null values and outliers were excluded from the statistical analysis, and the 729 remaining values of retail densities were divided into 5 categories using the natural breaks method of classification (Table 22). A cartographic representation of the convenience retail density along Montréal's commercial streets was produced (Fig. 44 to 47).

LABEL	Range	Frequency
Null Values	0.00	453
"Lower Density"	0.01 – 1.78	273
	1.79 – 3.00	185
"Intermediate Density"	3.01 – 4.37	127
"Higher Density"	4.38 – 6.30	80
	6.31 – 9.96	64
Outliers	9.97 – 25.22	11

Table 22. Classification – Convenience Retail Density per Street Segment
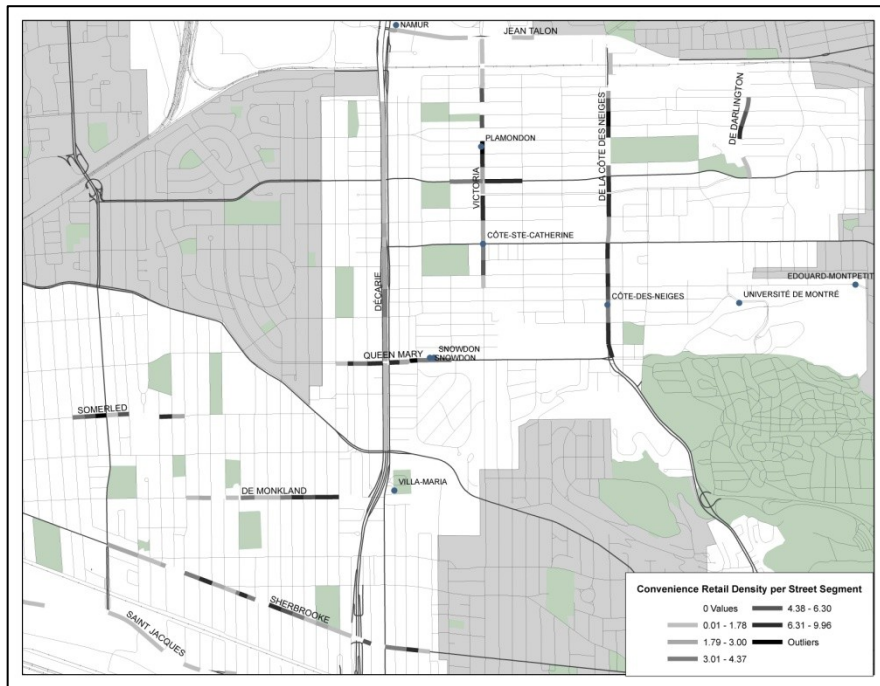
Figure 44. Map of Montréal's commercial arteries displaying the density of convenience retail activities per street segment (CDN-NDG).
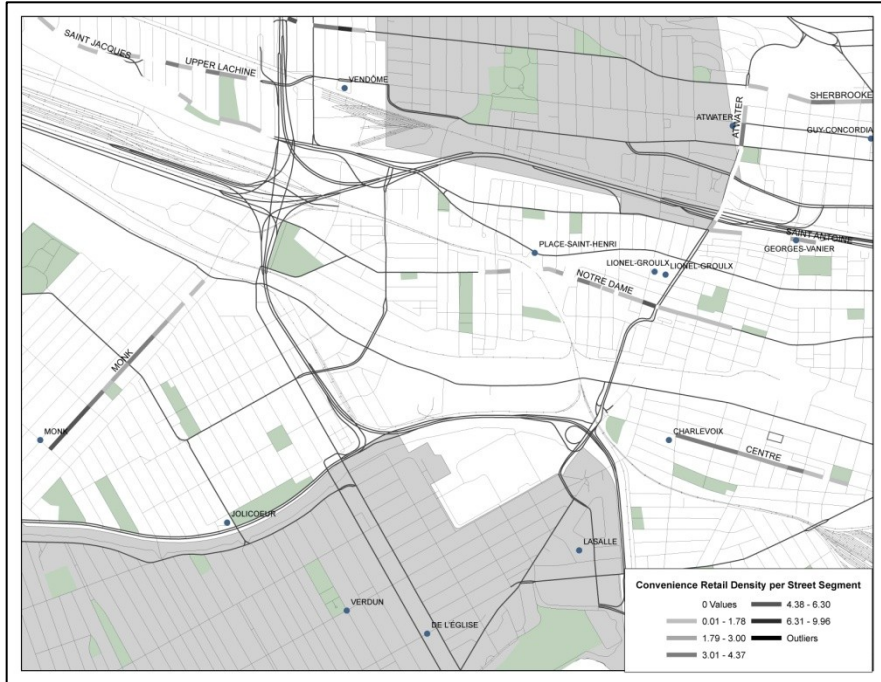
Figure 45. Map of Montréal's commercial arteries displaying the density of convenience retail activities per street segment (SO).
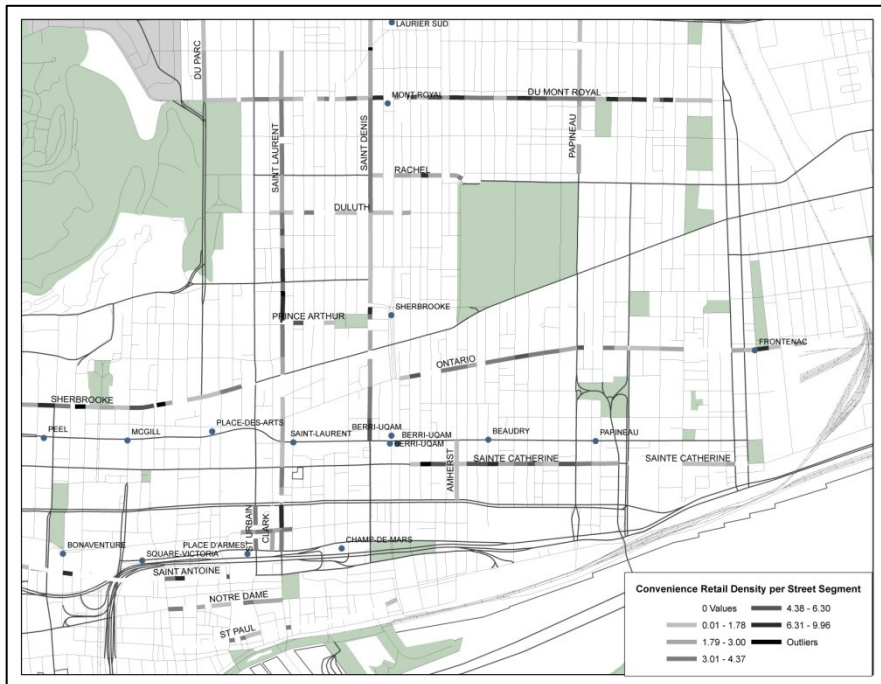
Figure 46. Map of Montréal's commercial arteries displaying the density of convenience retail activities per street segment (Chinatown, Latin Quarter, and the Village, VM).

Figure 47. Map of Montréal's commercial arteries displaying the density of convenience retail activities per street segment (AC).

Specialized Retail Density per Street Segment

The third data distribution deals with specialized retail density per street segment. As described earlier, specialized retail density was calculated by dividing the total number of comparison outlets along the street segment by the segment length. This result was then multiplied by 100 to obtain a ratio and allows for street segment density comparisons.

Commercial establishments dedicated to comparison and specialty goods and services account for 81.5% of the total number of commercial establishments

present in the census (REEM). However, there are still 239 street segments along which no such businesses can be found.

Again, the presence of the three inner-city shopping malls required particular attention since they strongly affect the data distribution. Indeed, the maximum density value of 142.94 corresponds again to *Place Versailles*, located along Sherbrooke Street East (MHM), which has 170 specialized retail establishments along a unique street segment. In addition to these three shopping malls, the exploration of the data distribution in ArcGIS® highlighted the presence of six other outliers. In total, the 9 highest specialized retail density values were excluded from this analysis.

Looking at the set of descriptive statistics, a street segment has on average 9.72 commercial establishments dedicated to specialized retail and services per 100 meters. Also, 50% of the street segments have less than 7.11 specialized retail establishments per 100 meters (Table 23).

	Entire Dataset N= 1,193	Null Values Excluded, Outliers Excluded N= 945
Minimum	0.00 (n=239, i.e. 20.03%)	0.44
Maximum	142.95	53.81
Mean	8.35	9.72
Median	5.34	7.11
Standard Deviation	11.33	8.92

Table 23. Descriptive Statistics – Specialized Retail Density per Street Segment

Classification

In order to allow for comparisons, as for retail and convenience retail density data distribution, the natural breaks method of classification was employed to organize values of specialized retail density (Table 24).

LABEL	Range	Frequency
Null Values	0.00	239
"Lower Density"	0.01 – 5.45	363
	5.46 – 10.99	297
"Intermediate Density"	11.00 – 18.67	163
"Higher Density"	18.68 – 31.65	90
	31.66 – 53.81	32
Outliers	53.82 – 142.95	9

Table 24. Classification – Specialized Retail Density per Street Segment

Figure 48. Map of Montréal's commercial arteries displaying the density of specialized retail activities per street segment (PMR, RPP and VMPE).
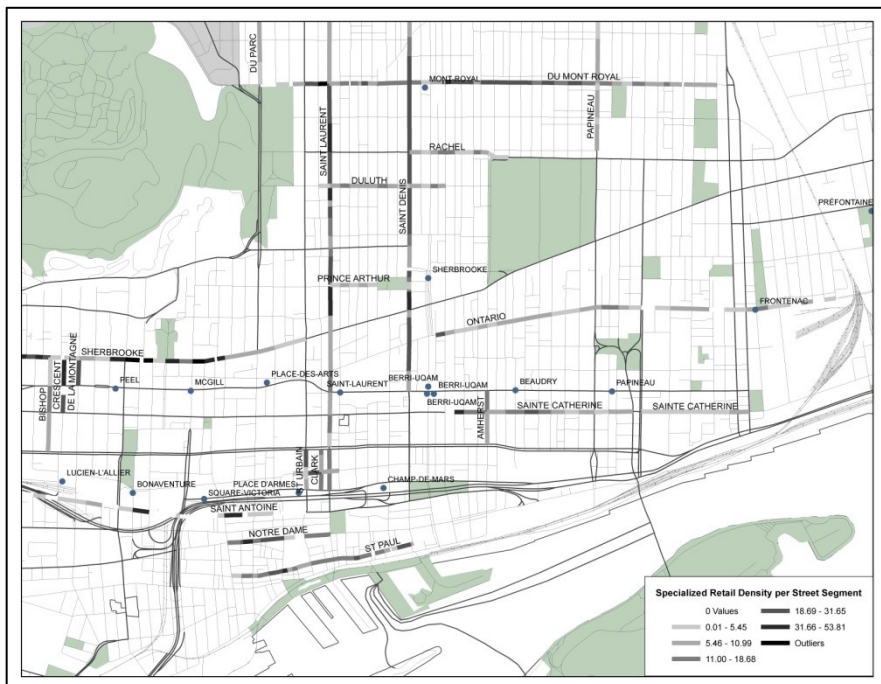
Figure 49. Map of Montréal's commercial arteries displaying the density of specialized retail activities per street segment (Downtown, Chinatown, Lower Plateau and the Village).
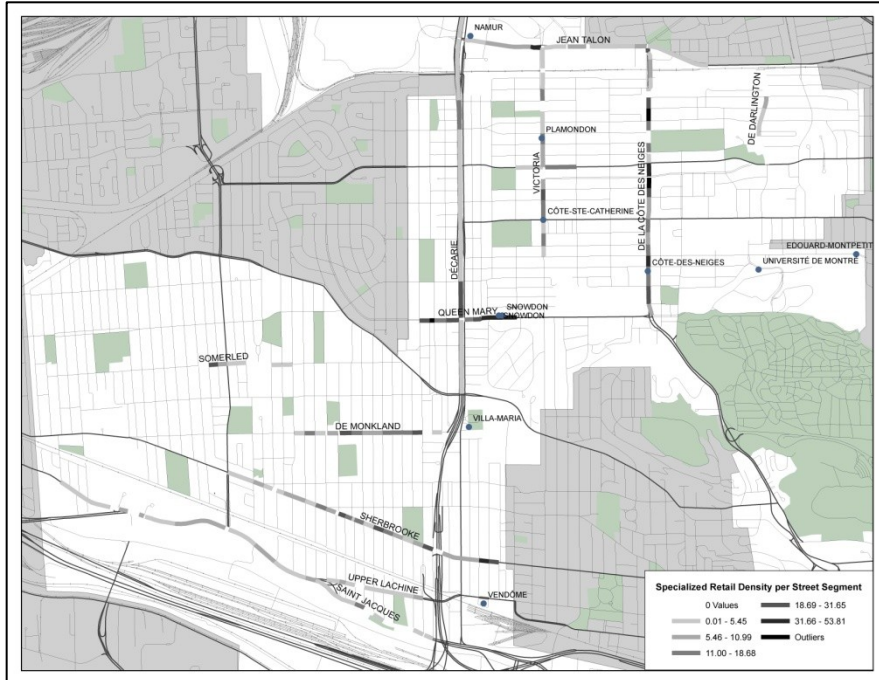
Figure 50. Map of Montréal's commercial arteries displaying the density of specialized retail activities per street segment (CDN-NDG).

Conclusion

These density indices were mapped in ArcGIS®. The cartographic representation allows us to capture the presence of local particularities and local clusters of retail activities within the commercial street.

ANALYSIS

Street Permeability and Retail Concentration

This analysis compares the level of permeability of clusters of convenience retail with the level of permeability of clusters of specialized retail. The permeability

was measured as the average distance between intersections on both sides of the street, and an average of both sides was produced. An index of permeability was calculated and allocated to each significant concentration of convenience and specialized retail.

Then, in order to test for the relationship between the level of permeability and the type of commercial offer at the local level, the level of permeability of the first quartile of concentrations of convenience retail was compared to the first quartile of concentrations of specialized retail.

The results suggest again the presence of a relationship between higher level of permeability and higher prevalence of convenience retail. Within the framework of this analysis, concentrations of convenience stores are observed along more permeable street segments than clusters of specialized retail. In fact, the highest concentrations of convenience retail have an average level of permeability of 99 meters between intersections, whereas this average goes up to 158 meters for specialized retail concentrations. Also, 50% of these convenience retail concentrations have an average permeability inferior to 88 meters (Table 25). As a reminder, the average street permeability for the 85 commercial arteries is 133.23 meters between intersections.

	Top 25% Convenience Retail Concentrations	Top 25% Specialized Retail Concentrations
Average (in meters)	99.38	158.18
Median (in meters)	88.13	149.20
Minimum (in meters)	59.62	93.18
Maximum (in meters)	240.83	312.09

Table 25. Comparison of levels of permeability within convenience and specialized retail concentrations.

The Impact of Parks, "Attractors", and Metro Stations on Retail Location

As part of the local analysis, this section focuses exclusively on three spatial elements, i.e. parks, attractors, and metro stations, to examine how their presence affects the spatial distribution pattern of convenience retail in particular. All three spatial components are important to consider as they may, to a certain extent, explain the presence of variants and exceptions in the traditional pattern of retail.

The analysis presented and described in the following section leads to initial considerations and general observations that need to be further developed and examined into more details. Yet, observations stemming from this analysis raise important issues with regard to how commercial streets function within our cities and how their vitality may be affected by the presence of certain physical elements of the built environment.

The impact of Parks on Convenience Retail Spatial Distribution

On a local scale, the hypothesis is that a presence of a public park along a commercial street may hinder the development of convenience stores and create a discontinuity in the spatial distribution of retail activities.

For the purpose of this research, all parks incorporated in the study area are mapped with ArcGIS® using the DMTI shapefile "Parks and Recreation" (DMTI Spatial Inc., 2009) that includes parks, recreation, cemeteries, sports field, garden, etc.

In order to determine the impact of a park on the intensity of commercial activities, the average retail density along the street segments on the opposite side of the park was compared to the average retail density of the street divided by two, allowing for street side comparisons.

Within the sample of 85 commercial streets, 22 commercial streets comprise either one (17 streets) or two (5 streets) parks. These parks can either be centrally (17) or peripherally located (10).

The results of this analysis do not allow us to conclude that the presence of a park automatically affects the spatial distribution of commercial activities in a significant manner. Observations stemming from this analysis simply suggest that the presence of a park may have a stronger impact on retail density when the park is peripherally located, i.e. towards the edges of the street. This could confirm the idea that a combination of spatial characteristics need to be considered to measure the extent to which the presence of a park will affect retail activities the vitality of commercial activities in general.

In addition, the impact of a park may also vary according to the season considered. For example, during summer months, parks usually attract people, inducing higher level of activity, which may also support local retail activities in close proximity. In contrast, during winter months, parks may be perceived as a barrier or an obstacle to be crossed by pedestrian, discouraging costumers to shop on the commercial street.

A set of different variables is therefore important to consider when seeking to measure and assess the impact of parks on convenience retail activities. The following maps and pictures illustrate several cases where parks affect or do not affect the density of convenience retail activities along the commercial street.

Figure 51. Boulevard Monk (SO): Impact of the park on convenience retail spatial distribution.

Figure 52. Commercial activities along the park on Boulevard Monk (SO).

Source: Google Street View, 2011.

Figure 53. Rues Villeray and Jarry (VMPE): Impact of the park on convenience retail spatial distribution.

Figure 54. Commercial activities along the Park on Villeray Street (VMPE).

Source: Google StreetView 2011.

Figure 55. Rue Fleury Est (AC): Impact of parks on convenience retail spatial distribution.

The impact of Attractors on Convenience Retail Spatial Distribution

As mentioned in the literature review, the "anchor theory" contends that the presence of a certain category of establishments referred to as "attractors" or "anchors" generates higher level of retail activity in its close proximity and at

specific hours or periods of time. For the purpose of this analysis, the intent is to verify whether the presence of an attractor is associated with higher concentration of convenience stores, even in spatial conditions that are supposedly not favorable to the development of such activities, i.e. along low permeable or peripheral street segments.

As described in the methodology section, a classification of the commercial offer was developed and a distinct category was created to include all commercial establishments that were identified as "attractors":

- Elementary and Primary Schools;

- Universities;

- General Hospitals;

- Museums and Heritage Sites;

- Movie theaters;

- Metro Station (These will be the subject of an individual analysis in the following section).

This analysis only seeks to raise the reader's attention regarding the significance of attractors to examine local commercial streets vitality and level of activity. This analysis does not lead to rigorous conclusions. Only general observations that remain open to discussion and require further analysis stem from this preliminary analysis.

Prior to the analysis, a first comment is to be made concerning the attractors located along major commercial arteries such as Boulevard Saint Laurent, Rue

Saint Denis, Avenue du Parc etc… As these arteries feature high levels of retail density along the entire street, it seems difficult to isolate the individual impact of the attractor from other spatial determinants in order to explain the concentration and more generally the spatial distribution of commercial activities along the street. These attractors were therefore excluded from this analysis.

Movie Theaters:

Within the Census of Commercial Establishments, only two movie theaters are located along traditional commercial arteries, *Cinema Beaubien* (Rue Beaubien, RPP) and *Cinema Le Paradis* (Rue Hochelaga, MHM). However, contrary to the assumptions stated by the Anchor theory, when located along low permeable street segments or in a peripheral position, the presence of a movie theater is not associated with higher level of convenience retail density, and no concentration of convenience retail along adjacent street segments can be observed. In addition, *Cinema Beaubien* is located at the corner of a public park, which may also account for the low level of density observed. Moreover, theaters are suspected to attract higher level of activity at a specific time, such as evenings. However, this variable can't be captured within the framework of this analysis.
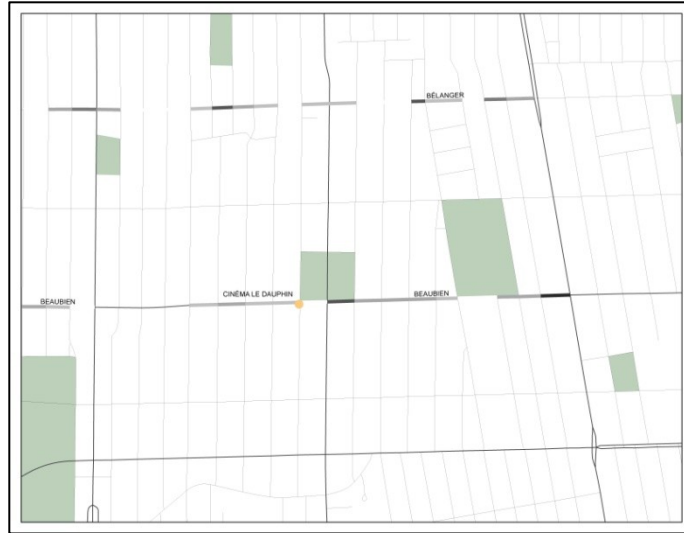
Figure 56. Rue Beaubien Est (RPP). Impact of *Cinema Beaubien* on convenience retail spatial distribution.

Figure 57. *Cinema Beaubien* (RPP), Rue Beaubien, Surrounding environment.

Source: Google Street View, 2011.

Public Libraries and "Maison de la Culture" – Primary and Elementary Schools

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To the extent of this analysis, the presence of public libraries, "Maison de la Culture" and schools along commercial streets has no significant impact on the concentration of retail activities. In general, when integrated within the urban tissue, namely when close to a metro station or located in dense retail areas, the presence of such establishments may support or strengthen the presence of retail activities that are already in operation. On the other hand, these establishments may also benefit from the environment within which they are integrated. Again, it is difficult to isolate the impact of such establishment on surrounding activities. In addition, when located along low permeable or peripheral street segments, these establishments do not seem to act as a generator of convenience retail activities.
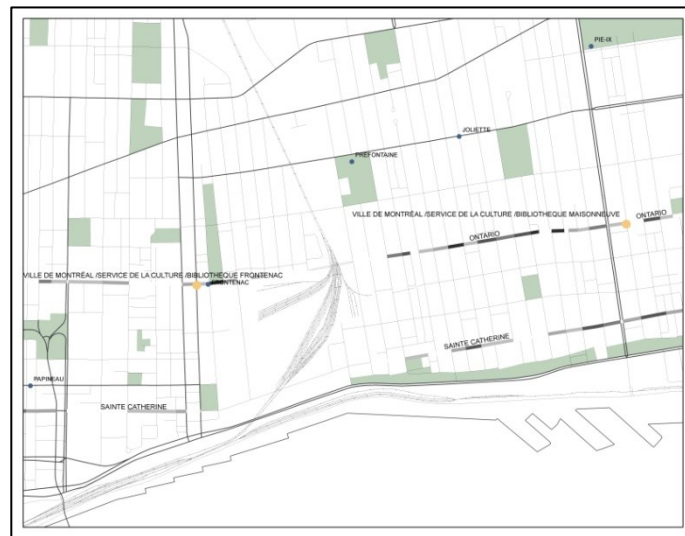
Figure 58. *Bibliothèque Frontenac et Bibliothèque Maisonneuve*, Rue Ontario (VM)

The Bibliothèque Frontenac is located in a dense area and close to the metro station, explaining the greater level of convenience retail density along adjacent street segments.

Figure 59. *Bibliothèque Frontenac*, Rue Ontario (VM), surrounding environment.

Source: Google StreetView, 2011.

Universities:

Both Concordia and McGill universities have buildings located along commercial streets included in the dataset. However, given their downtown location where commercial arteries feature high level of retail density, it is complicated to assess the impact of such establishments on the presence of convenience stores in the neighborhood. Other spatial determinants need to be taken into consideration.

General Hospitals:

In contrast, looking at the impact of general hospitals on the spatial distribution of retail activities, higher levels of convenience retail density can be observed in the vicinity of the establishment. This configuration may yet be explained by the need to provide pharmacies, i.e. convenience stores, in close proximity to such establishments.

Figure 60. *Hôpital Général Fleury*, Rue Fleury Est (AC).

To conclude, the results of these preliminary analysis only allows us to discuss general observations regarding the impact of attractors on surrounding retail activities, convenience retail in particular. Contrary to the "anchor theory", the presence of an attractor along Montréal's commercials street does not automatically support the concentration of convenience retail in close proximity. However, a finer analysis that would include a combination of spatial characteristics is required to fully grasp the extent to which attractors influence convenience retail activities.

The impact of Metro stations on Convenience Retail Spatial Distribution

Purpose

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This analysis seeks to determine whether the presence of a metro station along or in close proximity to a commercial street has an impact on the spatial distribution of retail activities, specifically convenience stores. A metro station is suspected to act as a generator of pedestrian activity, favoring the concentration of convenience retail activities within walking distance.

The purpose of this analysis is to explore the impact of a metro station, capturing the presence of regularities and consistencies in the spatial distribution pattern of convenience retail around a metro station. A typology is built, describing the variety of spatial configurations that combine a metro station, commercial activities, and other physical elements of the urban form.

This analysis concludes with only general observations and considerations. These preliminary results hence require further analysis. These considerations are particularly relevant for discussing the principles and practical applications of Transit Oriented Development (TOD) models.

Methodology

Morphological Approach: Within the framework of this research, the first step consists in a visual assessment of the different patterns based on cartographic evidence. Emphasis is then given to the study of spatial configuration, i.e. the relative position of the metro station within the commercial street. In addition, the presence of physical barriers and particular street configurations are taken into consideration.

"Numerical" Analysis: This visual assessment is then completed by "numerical" results. The objective is to verify whether clusters of convenience retail are most likely to be located within a certain distance from the metro station. A metro station is "attached" to a commercial street when the street as a whole or some street segments are located within a distance of 350 meters. This range was chosen as it is widely accepted in the literature as the average distance people are willing to walk for their work, school or shopping trips (Iacono et al., 2008). A metro station can be attached to several commercial streets, especially when commercial arteries are close to each other or when they intersect. The impact of the metro station must then be differentiated according to each street considered. The convenience retail density within the area is compared to the average density along the commercial street. If the density is higher than the average density along the street, the impact of the metro station is considered as significant.

Analysis

As part of this analysis, first to be considered is the relative position of the metro station with the commercial street. Based on previous visual assessments, a key distinction is to be made between metro stations located on the commercial street per se, and metro stations located on an adjacent street.

When metro stations are located along the commercial street per se, another differentiation is to be made according to their position with regard to the commercial street, i.e. centrally or peripherally located. Furthermore, the

presence of physical barriers as well commercial streets in close proximity may also play a role in explaining the impact of the metro station.

Second, when the analysis focuses on the impact of metro stations located on an adjacent street, the analysis is less straightforward as the metro station is integrated within a neighborhood, usually serving different purposes, e.g. work, universities, entertainment, and shopping trips.

Results

- First Configuration

Looking at the first configuration, i.e. the metro station is located along the commercial street per se, several patterns can be observed and described.

1. The metro station is in a central position within the commercial street.

The presence of the metro station has a significant impact on commercial activities since, in all situations, the convenience retail density within the 350 meters distance range is higher than the average convenience density along the entire street. Within this first set of configuration, all commercial streets correspond to predominantly convenience or mixed retail streets, which implies that the presence of a metro station strengthens the development of such commercial activities.

Figure 61. Pattern 1.1.

The metro station is centrally located along the street per se and acts as a generator of convenience retail activities within a 350 meters distance range.

Figure 62. Jarry Metro Station (VMPE).

The impact of Jarry metro station on convenience retail spatial distribution along Jarry Street.

Metro Station	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
Jarry	Rue Jarry, VMPE	1.99	2.22
Frontenac	Rue Ontario, VM	1.40	1.46
Plamondon	Av. Victoria, CDN-NDG	3.83	3.93
Côte Ste Catherine	Av. Victoria, CDN-NDG	3.83	5.13
Mont Royal	Av. Mont Royal, PMR	3.26	3.45
Cadillac	Rue Sherbrooke Est, MHM	1.74	1.74
Langelier	Rue Sherbrooke Est, MHM	1.74	2.13

Table 26. Pattern 1.1: Overview Table. Impact of Metro station on convenience retail density.

2. The metro station is in a peripheral position, i.e. towards the edge of the commercial street.

Again, the impact of the metro station may be considered as significant as concentrations of commercial establishments, and more particularly convenience stores, are observed within the distance range, regardless of the presence of physical barriers.

Within this set of configurations, two metro stations are located along the commercial street but nearby a physical barrier. For instance, Snowdon metro station, along Chemin Queen Mary (CDN-DNG), allows for the development of convenience retail activities despite the occurrence of Boulevard Décarie as a major obstacle. Although both Chemin Queen Mary and Boulevard Henri

Bourassa are specialized retail oriented streets, the presence of the metro station

along the commercial street generates higher level of convenience retail activities

in close proximity.

Second, Monk and Charlevoix metro stations present a similar configuration:

Both located along the commercial street but in a peripheral position, their

presence still favors the concentration of convenient retail activities along nearby
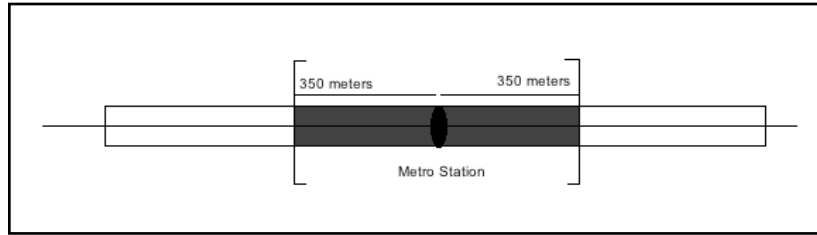
street segments.
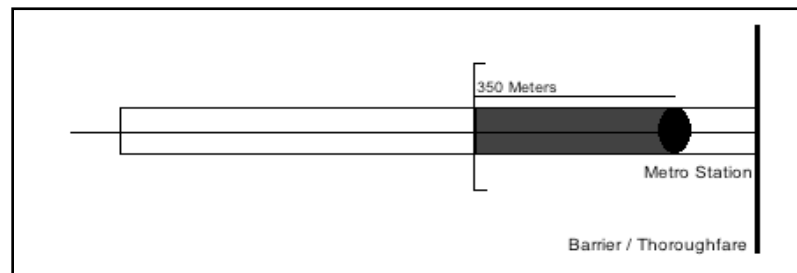
Figure 63. Pattern 1.21.

The metro station is peripherally located along the commercial street per se and acts as a generator of convenience retail activities within a 350 meters distance range, regardless of the presence of physical barriers.

Figure 64. Henri Bourassa Metro Station (AC)

The impact of Henri Bourassa metro station on convenience retail spatial distribution along Boulevard Henri Bourassa.
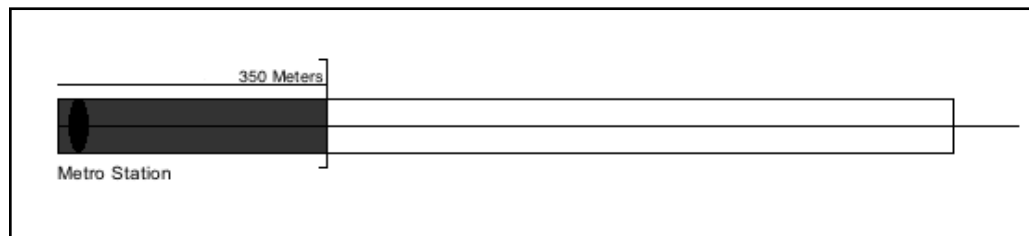
Figure 65. Pattern 1.22.

The metro station is peripherally located along the commercial street per se and acts as a generator of convenience retail activities within a 350 meters distance range.
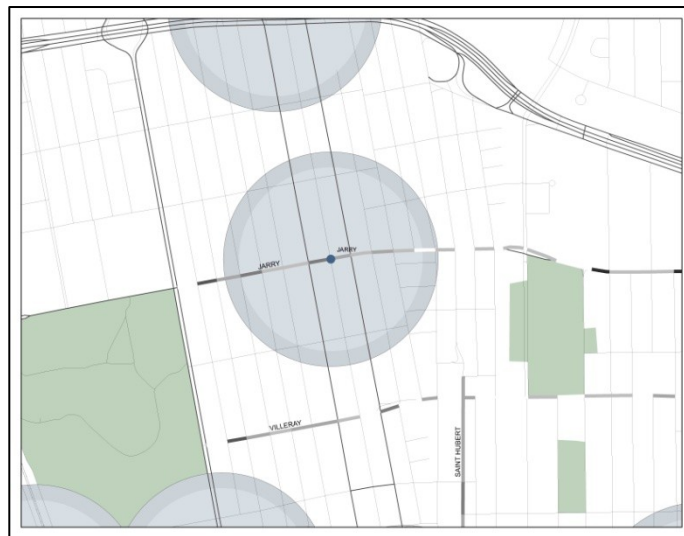
Figure 66. Charlevoix Metro Station (SO)

The impact of Charlevoix metro station on convenience retail spatial distribution along Rue du Centre.

Metro	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
Monk	Blvd Monk, SO	2.27	4.54
Charlevoix	Rue du Centre, SO	2.30	3.79
Snowdon	Ch. Queen Mary, CDN-NDG	5.12	6.43
Henri Bourassa	Blvd Henri Bourassa, AC	1.56	2.46

Table 27. Pattern 1.2: Overview Table. Impact of Metro station on convenience retail density.

Within this first set of configurations, although the metro station is located on the commercial street per se, its impact on commercial activities is not always as significant. Two additional patterns are described here.

3. The Metro station is located along the commercial street but "outside" the commercial segments.

The metro station is actually located outside the commercial street per se, i.e. only peripheral street segments are within walking distance from the metro station. In this configuration, the presence of a metro station does not have a significant impact on convenience retail activities as these peripheral street segments still present lower levels of convenience retail density.
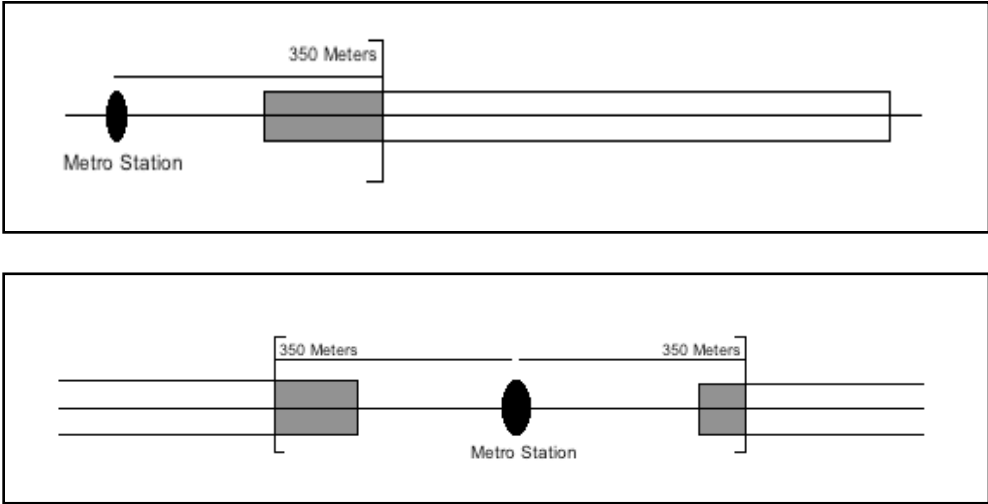
Figure 67. Pattern 1.3.

The metro station is located along but outside the commercial street segments and does not significantly affect the convenience retail density along the segments located within walking distance.
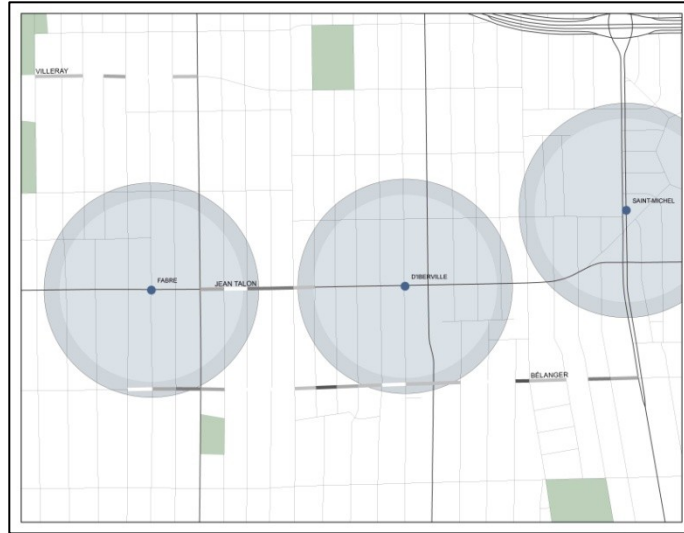
Figure 68. Fabre and d'Iberville Metro Stations (VMPE)

The impact of Fabre and d'Iberville metro stations on convenience retail spatial distribution along Jean Talon Est.

Regarding Villa Maria metro station, the numerical analysis confirms the idea that when located outside the commercial street, the metro station would not act as a generator of pedestrian activity and would not have a significant impact on convenience retail activities. However, in this specific case, despite the presence of the physical barrier, namely Boulevard Décarie, higher levels of pedestrian activity are usually observed because the avenue is the only connector to the neighborhood. One should therefore be cautious looking at the results; a finer analysis capturing the level of pedestrian traffic, should be undertaken to look at such unique configurations.
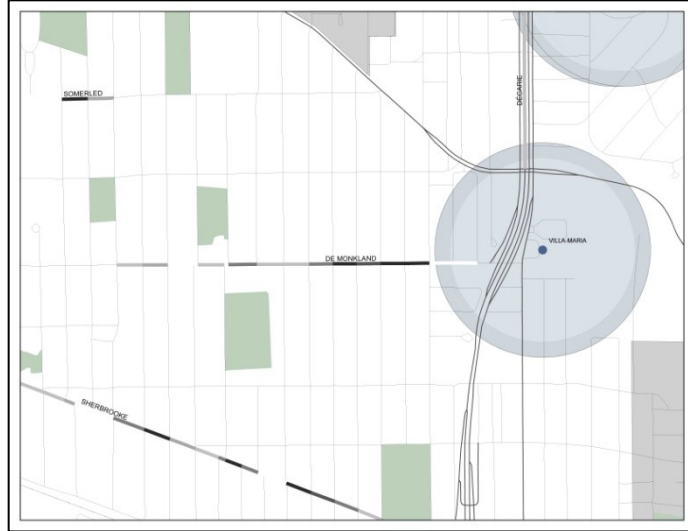
Figure 69. Villa Maria Metro Station (CDN-NDG).

The impact of Villa Maria metro station on convenience retail spatial distribution along Avenue Monkland.

Metro	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
Beaubien	Rue Beaubien Est, RPP	1.76	0.98
Fabre	Rue Jean Talon Est, VMPE	2.40	2.12
D'Iberville	Rue Jean Talon Est, VMPE	2.40	1.44
Jean Talon	Rue Jean Talon Est, RPP	1.81	2.90
Villa Maria	Av. Monkland, CDN-NDG	2.81	0.00

Table 28. Pattern 1.3: Overview Table. Impact of Metro station on convenience retail density.

4. The metro station is located along the commercial street in close proximity to a major barrier.

With regard to the fourth configuration, the presence of a physical barrier would hinder the development of convenience retail activities. Therefore, the presence of a metro station has no impact when the closest commercial street also serves as a thoroughfare.
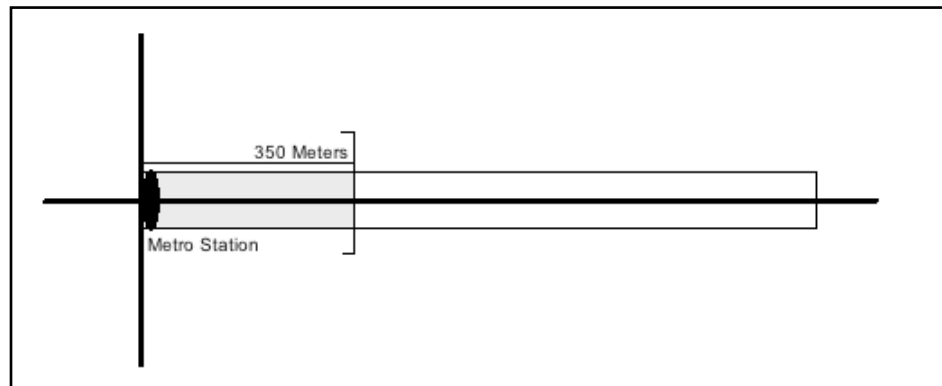
Figure 70. Pattern 1.4.

The metro station is located along the commercial street but in close proximity to a physical barrier, impeding the development of convenience retail activities.
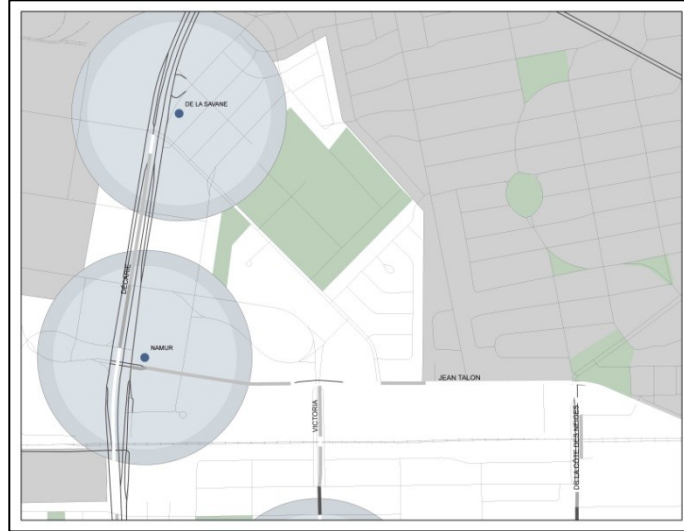
Figure 71. De la Savane and Namur Metro Stations (CDN-NDG).

The impact of De la Savane and Namur metro stations on convenience retail spatial distributions along Jean Talon Ouest and Boulevard Décarie.

Metro	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
G. Vanier	Rue St Antoine, VM	0.78	0.67
Atwater	Av. Atwater, VM	0.46	1.00 (Place A. Nihon)
Namur	Rue Jean Talon Ouest, CDN-NDG	0.38	1.41
	Blvd Décarie, CDN-NDG	1.08	0.48
De la Savane	Blvd Décarie, CDN-NDG	1.08	0.26

Table 29. Pattern 1.4: Overview Table. Impact of Metro station on convenience retail density.

First Configuration: Results and Discussion

This first set of analysis lead to three general remarks:

- The impact of a metro station is more likely to be significant when it is located on a commercial street per se, regardless of its relative position along the street (i.e. central or peripheral). This configuration mostly concerns convenience and mixed retail oriented streets.

- In contrast, the impact of a metro station is limited when located along the given street but outside of the commercial street segments. The metro generally provides accessibility to an area or a neighborhood.

- Finally, the presence of a metro station has no impact when located nearby major barriers, or along major roads, thoroughfares, or highly specialized streets that favor automobile accessibility over pedestrian and local activities.

- Second configuration

The second part of the analysis investigates the impact of metro stations located on an adjacent street on convenience retail activities. The analysis of these configurations is more complex since metro stations usually serve an entire neighborhood for different purposes (access to universities, museums, shopping districts, etc…). As a consequence, patterns are less easy to capture, and the impact of metro stations difficult to isolate from the impact of other spatial determinants. Nevertheless, a few similar spatial configurations can still be depicted and explained.

1. The metro station is located on an adjacent street but still serving a local commercial artery

The metro station has a significant impact on the distribution of commercial activities, regardless of its relative position with the commercial street (i.e. central or peripheral). Besides, the presence of physical barriers does not prevent convenience retail activities from clustering around the metro station (see for example Papineau and Parc metro stations). Finally, the impact of the metro station is significant for both convenience and specialized retail oriented streets.
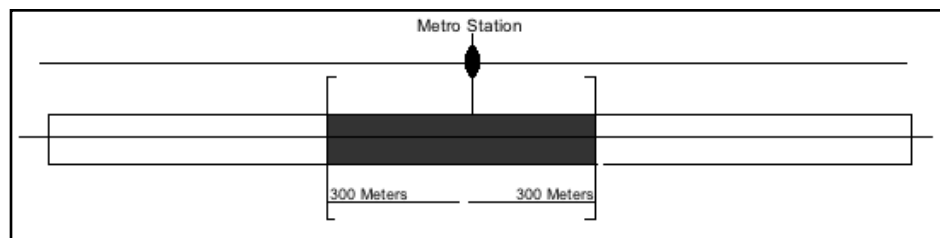
Figure 72. Pattern 2.11.

The metro station is located on an adjacent street, but in a central position to the commercial artery it serves.
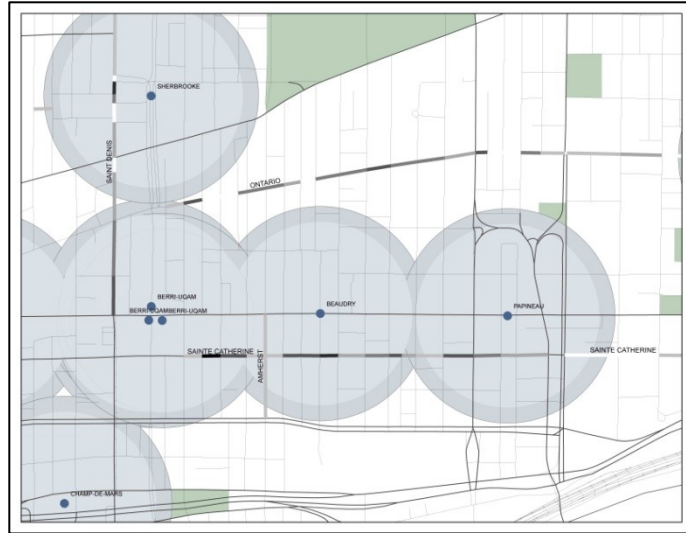
Figure 73. Beaudry and Papineau Metro Stations (VM).

The impact of Beaudry and Papineau metro stations, located on Boulevard Maisonneuve, on convenience retail spatial distribution along Sainte Catherine Est (SDC du Village).
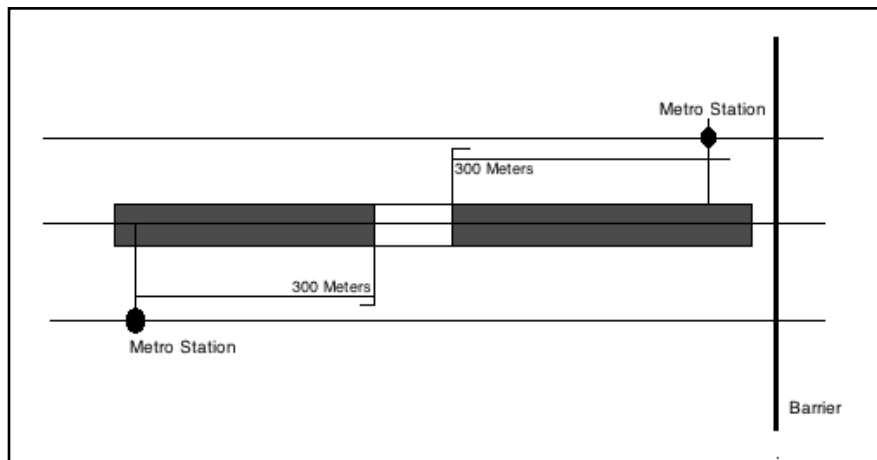
Figure 74. Pattern 2.12.

The metro station is located on an adjacent street and in a peripheral position to the commercial artery it serves.
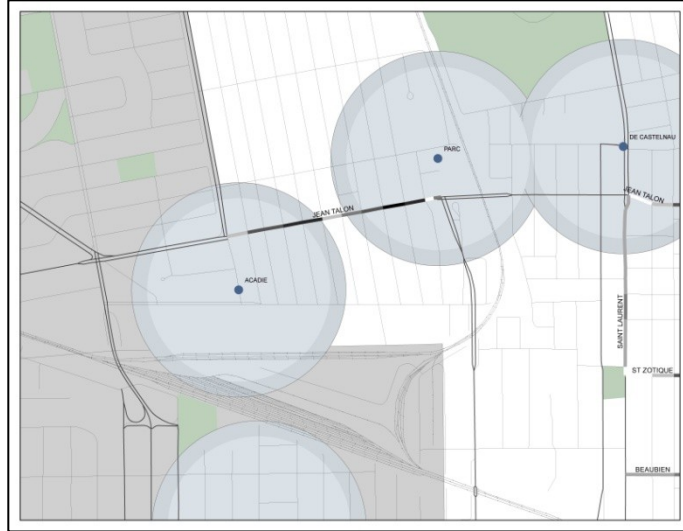
Figure 75. Acadie and Parc Metro Stations (VMPE).

The impact of Acadie and Parc metro stations on convenience retail spatial distribution along Jean Talon Ouest (VMPE).

Metro Station	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
Beaudry	Rue Ste Catherine, VM	3.51 (Place Dupuis Excluded)	3.88
Papineau	Rue Ste Catherine, VM	3.51	3.14
Jean Talon	Rue St Hubert, VMPE	1.82	1.48
De Castelnau	Rue Jean Talon, RPP	1.81	1.99
Parc	Rue Jean Talon O, VMPE	5.13	5.22
Acadie	Rue Jean Talon O, VMPE	5.13	5.74
Place Saint Henri	Rue Notre Dame O, SO	1.30	0.77

Lionel Groulx	Rue Notre Dame O, SO	1.30	1.37
Crémazie	Rue Lajeunesse, AC	1.38	1.92

Table 30. Pattern 2.1: Overview Table. Impact of Metro stations on convenience retail density.

2. The metro station is located on an adjacent street so as to serve major commercial arteries or shopping districts.

In this scenario, assessing the impact of the metro station on surrounding commercial activities is more complex since those major commercial arteries have high levels of retail density all street long. It is hence difficult to separate out the impact of the metro station from other spatial determinants influencing commercial activities. Also, these configurations include numerous examples where one metro station serves several commercial streets.
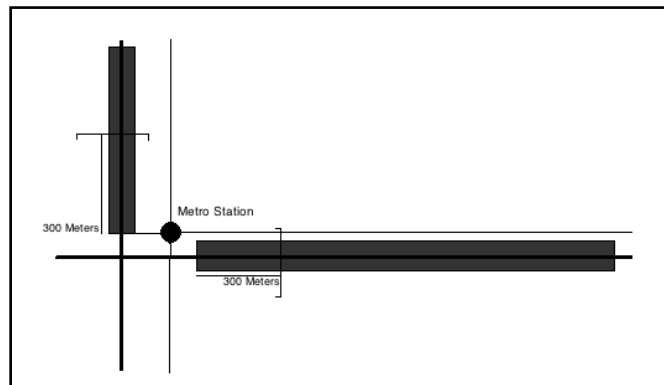
Figure 76. Pattern 2.2.

The metro station is located on an adjacent street so as to serve several major commercial arteries.
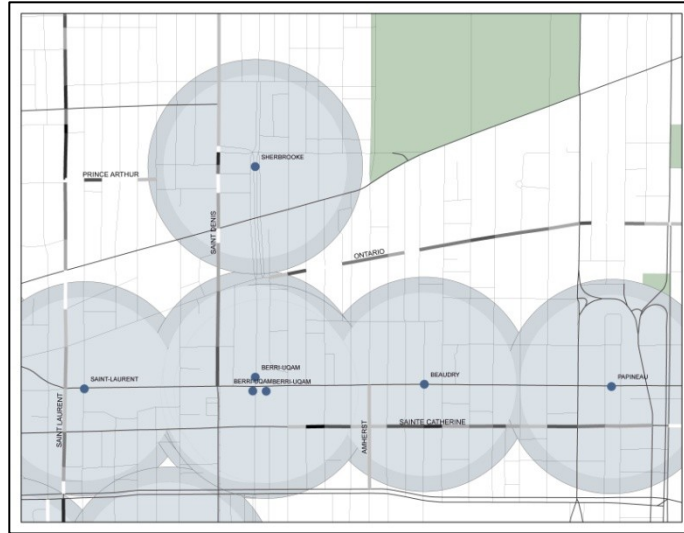
Figure 77. Sherbrooke, Berri Uqam, Beaudry and Papineau Metro Stations (VM).

Sherbrooke, Berri Uqam, Beaudry and Papineau metro stations serving Saint Denis (VM) and Sainte Catherine (SDC Village) streets.

Metro Station	Commercial Street
Sherbrooke	Rue St Denis, VM
St Laurent	Blvd St Laurent, VM
Mont Royal	Rue St Denis, PMR
	Av. Du Mont Royal, PMR
Laurier	Rue St Denis, PMR
Berri UQAM	Rue St Denis (SDC), VM
	Rue Ste Catherine, VM

Table 31. Pattern 2.2. Overview Table. Metro Stations serving main commercial arteries in Montréal.

3. The metro station is located on an adjacent street and in the vicinity of particular street configurations (Downtown, Chinatown, Old Montreal).

In this scenario, assessing the impact of the metro station on surrounding commercial activities is complex since those metro stations serve a neighborhood within which they are centrally located. They usually serve several purposes and are not only dedicated to commercial streets and shopping trips. For example, metro stations located in the downtown area (Place des Arts, McGill, Peel, and Guy-Concordia) provide access to universities, museums, as well as commercial streets (Sherbrooke West, Crescent, Bishop, etc…). The second example is Chinatown. Within these specific configurations, the distribution of commercial activities is mostly informed by the urban structure and planning policies. Yet, the presence of a metro station is critical for the viability of these commercial arteries but does not play a key role in explaining the type of activity provided.
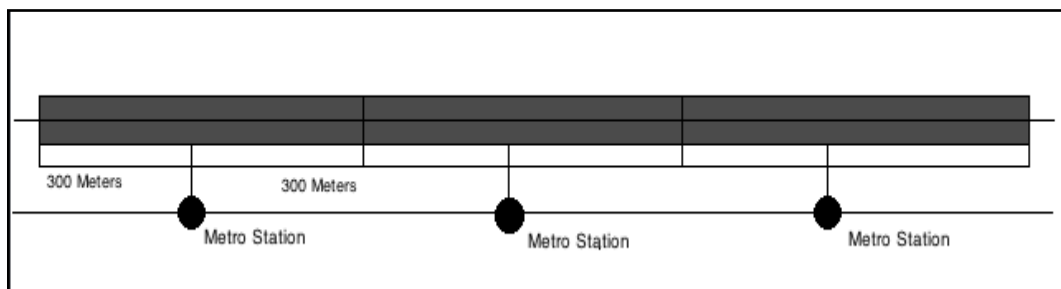
Figure 78. Pattern 2.3.

Metro Stations located on an adjacent street serving providing access to a neighborhood in general.
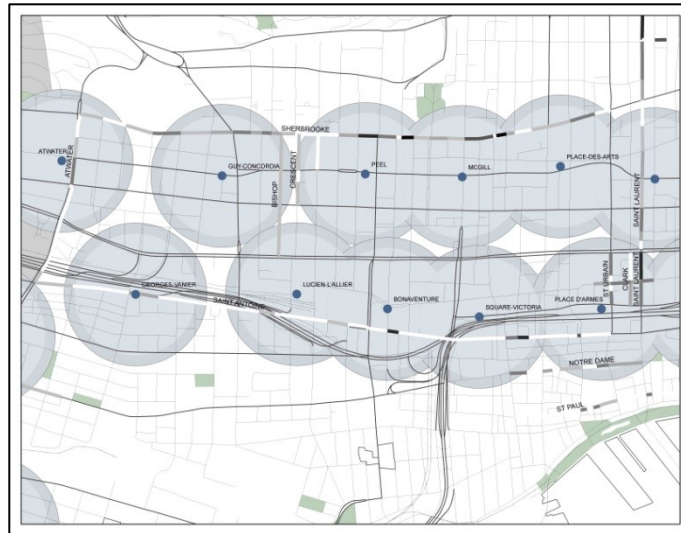
Figure 79. Metro stations in Downtown Montréal.

Metro Stations (Guy Concordia, Peel, McGill, Place des Arts; Lucien L'Allier, Bonaventure, Square Victoria and Place d'Armes) serving the downtown Area, Chinatown and the Old Montréal.

Metro Station	Neighborhood	Commercial Street
Guy Concordia – Peel – McGill – Place des Arts	Downtown, Museums, Universities	Rue Sherbrooke, VM Rue Crescent, VM Rue Bishop, VM Rue De la Montagne, VM
Place d'Armes	Chinatown, Old Port	Rue St Urbain, VM; Rue Clark, VM; Blvd St Laurent, VM; Rue De la Gauchetière, VM. Rue Notre Dame, VM.

Table 32. Pattern 2.3: Overview Table. Montréal's metro stations serving major shopping destinations areas.

4. The Metro station is located on an adjacent street in close proximity to physical barriers.

In this last configuration, the presence of a metro station has no impact on convenience retail activities found along adjacent commercial arteries. Those metro stations are located nearby major roads or thoroughfares, hindering the development of convenience stores and services within walking distance from the metro station.
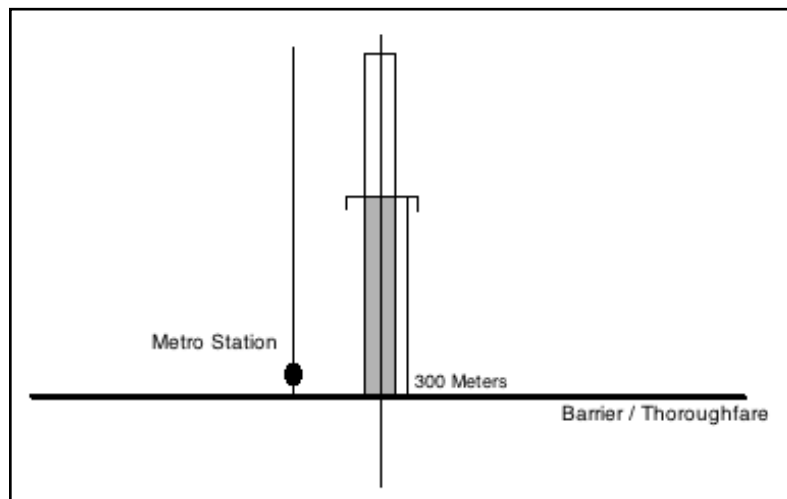
Figure 80. Pattern 2.4.

The metro station is located on an adjacent street in close proximity to major physical barrier.
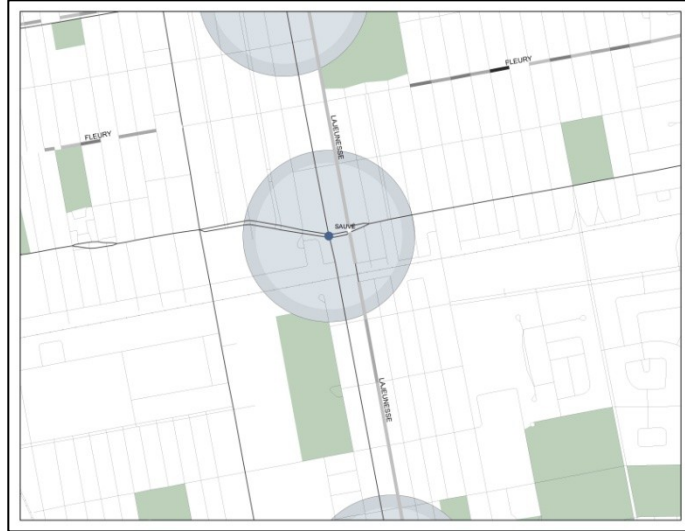
Figure 81. Sauvé Metro Station (AC)

Impact of Sauvé metro station on convenience retail spatial distribution along Lajeunesse Street.

Metro Station	Commercial Street	Average Conv. Retail Density along the street	Conv. Retail Density within walking distance from the Metro Station
Sauvé	Rue Lajeunesse, AC	0.67	0.39
Lucien l'Allier	Rue St Antoine, VM	0.78	0.32
Bonaventure	Rue St Antoine, VM	0.78	1.43
Square Victoria	Rue St Antoine, VM	0.78	1.34
Place d'Armes	Rue St Antoine, VM	0.78	0.00

Table 33. Pattern 2.4: Overview Table. Impact of Metro Station on convenience retail density.

Second Configuration: Results and Discussion

The second set of patterns leads to more ambivalent conclusions.

Although located on an adjacent street, a metro station seems to have a significant impact on the distribution of commercial activities when serving a traditional commercial artery. In fact, convenience stores tend to cluster within walking distance from the metro station.

However, when a metro station is located on a peripheral street so as to serve major shopping destinations or a given district, it is impossible to isolate the impact of the metro station from other spatial determinants that could also explain the distribution of retail activities along commercial streets, and more particularly nearby the metro station.

Finally, as in the first configuration, when located in close proximity to major barriers or thoroughfares, the presence of a metro station is not associated with higher concentrations of convenience stores.

Conclusion and Discussion

CONFIGURATION	Position of the Metro Station	Impact of the Metro station
CONFIGURATION 1 – Metro Station located on the commercial street per se	Metro Station in central position	Significant Impact
	Metro Station in peripheral position	Significant Impact
	Metro Station "outside" the commercial street	Limited Impact
	Metro Station along thoroughfares or highly specialized streets	No Impact
CONFIGURATION 2 – Metro Station located on an adjacent street	Metro station on an adjacent street serving a local commercial artery	Significant Impact
	Metro station on an adjacent street serving major commercial arteries and shopping districts	Not measurable
	Metro station on an adjacent street serving specific configurations (Downtown, Chinatown…)	Not measurable
	Metro Station on adjacent street in close proximity to major barriers	No impact

Table 34. Summary Table

This table summarizes the eight spatial configurations that describe the impact of a metro station on the spatial distribution of convenience retail activities.

This analysis sought to explore the extent to which the presence of a metro station along or nearby a commercial street influences the spatial distribution of commercial activities, and more particularly convenience retail.

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Based on cartographic evidences and numerical analysis, several patterns were identified. First, when serving traditional and local commercial arteries, namely convenience or mixed retail oriented streets, the presence of a metro station seem to strengthen this type of commercial activities by providing access and local shopping opportunities to a pedestrian catchment area. In contrast, the presence of a metro station has less influence on the spatial distribution of convenience retail along highly specialized streets and/or major roads or thoroughfares. Additional spatial determinants account for explaining the spatial distribution of commercial activities.

This preliminary analysis only provides a general overview of how metro station may influence and play a role in explaining commercial streets' local dynamics. Yet, a better understanding of the relationship between metro station, commercial activity, and by extension pedestrian traffic, would be of great practical value for policy-makers and urban planners that support the development of TOD models.

CHAPTER 5 - CONCLUSION AND DISCUSSION

OVERVIEW OF THE RESEARCH

Over the past few years, diverse policies and strategies aiming at the revitalization of (local) Main Street and inner city neighborhoods were implemented in North American cities. These projects shed light on the actual significance of local commercial streets and urban centers for addressing sustainability issues.

This thesis investigates Montréal's commercial arteries through a morphological analysis. The primary purpose is to increase our knowledge of how commercial streets function within our cities by exploring the relationship between urban form, retail location, and retail activity. Furthermore, this research highlights the significance of some spatial characters to comprehend local commercial streets' underlying dynamics. Specifically, it was hypothesized that some spatial determinants pertaining to the level of permeability and the relative position of a commercial street have an impact on the spatial distribution of commercial activities, convenience retail in particular. One contribution of this research stems from the attempt to distinguish the impact of both spatial determinants according to the retail category considered.

The analysis was performed at two levels:

- On a global scale, i.e. taking the commercial street as a uniform spatial entity, the analysis provides a general picture of retail activities in Montréal and allows for basic but essential comparisons between these commercial arteries.

- On a local scale, i.e. focusing on internal street segments, the analysis seeks to capture the presence of local variations and regularities in the spatial distribution pattern of commercial activities within the street. More specifically, the analysis explores the impact of parks, attractors and metro station on the spatial distribution of convenience stores.

RESULTS

First of all, a typology of commercial streets was built upon a combination of commercial and morphological characteristics. This classification serves as a framework for understanding the following analyses and results, and provides a general overview of the diversity of spatial environments that characterize Montréal's commercial arteries. In total, the classification comprises four main categories of commercial streets, based on their spatial arrangement in the urban structure, as well as their retail functions.

At the global level, the results of the analysis suggest the presence of a relationship between street permeability and the predominant category of commercial offer. In fact, streets with higher level of permeability primarily favor convenience, and by extension, mixed retail activities, usually serving a local and

pedestrian catchment area. In contrast, as comparison goods rely on a wider catchment area, specialized retail seems to be less dependent upon street permeability.

In addition, to the extent of this analysis, both convenience retail and mixed retail oriented streets are most likely to be centrally located within the morphological unit, or the neighborhood they intend to serve. On the other hand, no such relationship could be observed when examining the relative position of specialized retail oriented streets.

The second-tier analysis was performed at the street level, i.e. focusing on internal street segments, in order to explore the spatial distribution pattern of commercial establishments within the street. This implies that commercial activities are not evenly distributed and that some spatial determinants may again favor the concentration of a certain category of services and amenities. Analogous queries were considered at the local level and comparable analyses were carried out.

First, with regard to the level of permeability, the results suggest that concentrations of convenience retail are located along more permeable street segments than concentrations of specialized retail. In addition, the analysis examined the impact of parks, attractors and metro stations on the localization and distribution of convenience retail activities. These analyses led to general considerations and preliminary results that require further development. First, the results indicate that a combination of spatial characters needs to be considered in order to assess the impact of a park on convenience retail activities. To the

extent of this analysis, the results suggest that when located towards the edge of the street, a park is most likely to disrupt the activity along the commercial artery. However, these results are based on preliminary observations and need to be further completed by finer analyses. Second, within the framework of this research, the presence of establishments defined as attractors (movie theaters, schools, public libraries, etc…) does not automatically generate higher levels of convenience retail activities along adjacent street segments. In contrast, the presence of a metro station along local commercial arteries oriented towards convenience or mixed retail activities generally strengthens this type of commercial activity as concentrations of convenience stores can be observed within walking distance from the metro station. On the other hand, when located along major roads, thoroughfares or highly specialized streets, a metro station does not act as a generator of convenience retail activities along adjacent street segments.

This research concludes with general observations and results that need to be further developed. This study focuses on the urban form and the spatial environment that characterizes Montréal's commercial streets as one factor underlying retail location and retail dynamics. Although a number of limitations, this research highlights the significance of spatial relationships, which have often been downplayed when approaching strategies of commercial revitalization.

CONTRIBUTIONS

The morphogenetic approach sheds light on the significance of the urban form and spatial relationships, i.e. internal elements of the urban structure, in contrast with more traditional approaches and analyses that focus on "external" considerations. Until recently, the majority of studies and strategies about commercial streets revitalization have given precedence to an economic approach in order to explain the "ideal" retail composition of a commercial street. Furthermore, these programs focus on physical improvements and urban design measures such as the renovation of facades, the widening of sidewalks, the planting of trees and the provision of pedestrian amenities to make this urban environment more attractive to pedestrians, residents and shoppers.

In contrast, through a morphological approach, the objective is to reveal the impact of spatial characteristics pertaining to the relative position and the level of permeability on the dominant type of commercial offer and the spatial distribution of retail activities. As a consequence, this research contributes to enhance our knowledge of how commercial streets function within our cities and how they are integrated within the urban tissue. It provides new and crucial insights for designing strategies aimed at modernizing and revitalizing traditional commercial arteries and local commercial areas. Moreover, this research provides relevant information for merchants and "business" people for instance in determining the optimal location for setting up a new commercial establishment. The results of this research could also provide key information to people working in *Sociétés de Développement Commercial* in order for them to better understand the

underlying dynamics and potential prospective for the development of these commercial arteries. Finally, this research raises key issues and questions at a time when the dominant planning discourse strongly advocates for mix-use neighborhoods that favor active transportation.

To conclude, this research fills a gap in the urban literature, which has not attached great value to the study of the urban form in the analysis of local commercial streets and activities.

FURTHER RESEARCH

This research proposes a new framework for approaching commercial streets and inner-city areas revitalization policies. In fact, a morphological analysis is suggested as a preliminary step when designing strategies aimed at drawing people and businesses back to inner-city neighborhoods. This research produces new findings that are worth study in more details so as to as increase our understanding of the relationship between urban form and location of retail activities. Suggestions for further research are described as follows.

First of all, other measures of the urban form could be scrutinized and their impact on the spatial distribution of commercial activities assessed.

Centrality is a key feature that is worth considering when looking at the spatial distribution of commercial activities within the city. Recent studies were carried

out by the "Human Space Lab"[5] in Italy, demonstrating the existence of a relationship between street centrality and retail density. The Multiple Centrality Assessment (MCA) was developed as a tool for mapping centrality in cities while allowing for a network analysis of urban streets (Porta et al., 2009). Applying this methodology in Montréal would be of great value since Montreal remains more of an "exception" in terms of spatial organization and configuration in North America. Indeed, Montréal's urban tissue could be more easily compared to European structures and city models. This method allows for a better coverage of the urban tissue and would permit comparison of commercial streets with ordinary streets in order to establish a relationship between street centrality and land use intensity.

In addition, the level of permeability was measured along the commercial street by taking the average distance between intersections on both sides of the street. This only allows for comparing commercial streets with each other. Therefore, using other permeability and connectivity measures that were developed in the literature (Dill, 2003; Song and Knapp, 2004) would be worth exploring. It would also be interesting to verify whether a relationship exists in Montréal between street connectivity and commercial intensity by applying space syntax methods and analytical techniques.

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[5] Human Space Lab - http://www.humanspacelab.com/

Also, accessibility studies could significantly complement the preliminary results of this research.

Lastly, this research should also be read in conjunction with transportation studies that attempt to explore the link between urban form, commercial offer and shopping travel behavior. Further analysis should be carried out to assess the impact of metro stations and other transit stops on the spatial distribution of commercial activities in diverse spatial environments. This knowledge would benefit recent urban planning movements such as New Urbanism, Transit-Oriented Development, Smart Growth, which promote the development of urban communities on a more local scale. All these strategies emphasize the need to provide local shopping opportunities in order to encourage pedestrian activity, and reduce automobile travel within the neighborhood.

To conclude, the morphological/morphogenetic approach brings a great range of new opportunities for researchers, urban practitioners and policy-makers when designing plans and strategies that seek to enhance the urban sustainability of our cities and improve the quality of life of their residents. This type of research is therefore worthwhile to consider to ensure a greater success of all commercial revitalization strategies.

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ANNEXES

ANNEX 1: SAMPLE OF MONTRÉAL'S COMMERCIAL STREETS

The following lists describes the 85 commercial streets and their spatial limits

used as a sample throughout this thesis.

AHUNTSIC CARTIERVILLE (AC)

- Boulevard Gouin Ouest: Du boulevard Laurentien à la rue Fréchette

- Boulevard Henri Bourassa: De la rue Meilleure à la rue Lajeunesse

- Rue de Salaberry: Du boulevard Laurentien à la rue Poincaré

- Rue Fleury Est (SDC Promenade Fleury) : De la rue Saint Hubert à l'avenue Papineau

- Rue Fleury Est : De l'avenue Papineau à la rue Gagnier

- Rue Fleury Ouest: Du boulevard Saint Laurent à la rue Meilleure

- Rue Lajeunesse I: Du boulevard Crémazie à la rue Frémont

- Rue Lajeunesse II: De la rue Sauvé au boulevard Gouin

CÔTE DES NEIGES - NOTRE DAME DE GRÂCE (CDN-NDG)

- Avenue Darlington : Du Chemin Bates à l'avenue Van Horne

- Avenue de Monkland: De l'avenue Girouard au boulevard Grand

- Avenue Somerled: Du boulevard Grand à l'avenue. Walkley

- Avenue Van Horne: De la rue Lemieux à la rue Lavoie

- Avenue Victoria: De la rue ean Talon Ouest au boulevard E. Montpetit

- Boulevard Décarie: Du Chemin Côte St Luc aux limites de la ville Mont Royal

- Chemin de la Côte des Neiges: De la rue Jean Talon Ouest au chemin Queen Mary

- Chemin Queen Mary: De l'avenue Ponsard à l'avenue Clanranald

- Chemin Upper Lachine : De l'avenue Girouard à la rue Saint Jacques

- Rue Jean Talon Ouest: du boulevard Décarie à l'avenue de Dieppe

- Rue Saint Jacques: Du boulevard Décarie à l'avenue Elmhurst

- Rue Sherbrooke Ouest: De l'avenue Grey au boulevard Cavendish

MERCIER HOCHELAGA MAISONNEUVE (MHM)

- Rue Beaubien Est: De la rue Albani à la rue Mignault

- Rue Hochelaga I: De la rue Curratteau à la rue Taillon

- Rue Hochelaga II: De la rue Dickson à la rue Duquesne

- Rue Ontario I : De la rue Moreau à la rue Darling

- Rue Ontario II: Du boulevard Pie IX à la rue Bennett

- Rue Ontario (SDC Promenade Ontario) : De la rue Darling au boulevard Pie IX

- Rue Sainte Catherine Est I: De la rue Moreau à l'avenue Bourbonnière

- Rue Sainte Catherine Est II (SDC Promenade Sainte Catherine): De l'avenue Bourbonnière au boulevard Viau

- Rue Sherbrooke Est I: De la rue Baldwin à la rue Aubry

- Rue Sherbrooke Est II: Du boulevard Viau aux limites de l'autoroute 25

PLATEAU MONT ROYAL (PMR)

- Avenue du Mont Royal (SDC): de l'avenue du Parc à la rue d'Iberville

- Avenue du Parc: De l'avenue Mont Royal à l'avenue Van Horne

- Avenue Duluth: de la rue Saint Urbain à la rue Saint Hubert

- Avenue Fairmount Ouest: Du boulevard Saint Laurent à la rue Hutchinson

- Avenue Laurier Est : De la rue Brébeuf à l'avenue Papineau

- Avenue Laurier Ouest: Du boulevard Saint Laurent à la rue Hutchinson

- Avenue Papineau: De la rue Rachel à la rue Saint Grégoire

- Boulevard Saint Laurent (SDC La Main): De la rue Sherbrooke à l'avenue Mont Royal

- Boulevard Saint Laurent : De l'avenue Mont Royal à l'avenue Van Horne

- Rue Bernard Est: Du boulevard St Laurent à la Hutchinson

- Rue Prince Arthur : Du boulevard Saint Laurent à la rue Laval

- Rue Rachel: De la rue Saint Denis à la rue du Parc Lafontaine

- Rue Saint Denis: De la rue Sherbrooke à la rue Laurier

- Rue Saint Viateur: Du boulevard Saint Laurent à l'avenue du Parc

SUD OUEST (SO)

- Boulevard Monk (SDC La Nouvelle Avenue): De la rue Saint Patrick à la rue Alllard

- Rue du Centre: De la rue Charlevoix à la rue Montmorency

- Rue Notre Dame Ouest: Du Square G.E Cartier à la rue Vinet

RIVIÈRE DES PRAIRIES POINTE AUX TREMBLES (RDP)

- Boulevard Saint Jean Baptiste: Du Fleuve Saint Laurent à la rue de Montigny

- Rue Notre Dame Est: De la 1ère à la 13ème Avenue.

- Rue Sherbrooke Est: De la 3ème à la 53ème Avenue.

ROSEMONT - LA PETITE PATRIE (RPP)

- Boulevard Saint Laurent (Little Italy): De la rue Saint Zotique à la rue Jean Talon

- Rue Beaubien I: Du boulevard Saint Laurent à la rue Saint Denis

- Rue Beaubien II: De l'avenue Papineau à la rue Boyer

- Rue Beaubien III: De la rue de Lorimier au boulevard Saint Michel

- Rue Bélanger: De la rue Garnier au boulevard Saint Michel

- Rue Jean Talon Est (Little Italy): Du boulevard Saint Laurent à la rue Henri Julien

- Rue Masson (SDC Promenade Masson): De la rue d'Iberville à la 12ème Avenue

- Rue St Hubert (SDC Plaza St Hubert): De la rue Bellechasse à la rue Jean talon

- Rue Saint Zotique (Little Italy): Du boulevard Saint Laurent à la rue Saint Denis

VILLE MARIE (VM)

- Avenue Atwater : De la rue Sherbrooke à la rue Saint Antoine

- Boulevard Saint Laurent I: De la rue Viger au boulevard R. Lévesque

- Boulevard Saint Laurent II: Du boulevard R. Lévesque à la rue
  Sherbrooke

- Rue Amherst: Du boulevard R. Lévesque au boulevard Maisonneuve

- Rue Bishop: Du boulevard R. Lévesque à la rue Sherbrooke

- Rue Clark: De la rue Viger au boulevard R. Lévesque

- Rue Crescent: De la rue Sainte Catherine à la rue Sherbrooke

- Rue de la Gauchetière: De la rue Côté à la rue Saint Dominique

- Rue de la Montagne: Du boulevard Maisonneuve à la rue Sherbrooke

- Rue Notre Dame Ouest (SDC Vieux Montréal): De l'avenue McGill au
  boulevard Saint Laurent

- Rue Ontario Est I: De la rue Berri à l'avenue Papineau

- Rue Ontario Est II: De l'avenue Papineau à la rue de l'Espérance

- Rue Saint Antoine: De l'avenue Atwater àla rue Saint Urbain

- Rue Saint Denis (SDC Quartier Latin): Du boulevard Maisonneuve à la rue
  Sherbrooke

- Rue Saint Paul: De l'avenue McGill à la rue Bonsecours

- Rue Saint Urbain: De la rue Viger au boulevard R. Lévesque

- Rue Sainte Catherine Est: De la rue de Lorimier à la rue Frontenac

- Rue Sainte Catherine Est (SDC du Village): De la rue Saint Hubert à la rue de Lorimier

- Rue Sherbrooke Ouest: De la rue Saint Urbain à l'avenue Atwater

VILLERAY SAINT MICHEL PARC EXTENSION (VMPE)

- Rue Villeray: Du boulevard Saint Laurent à l'avenue Papineau

- Boulevard Saint Michel: Du boulevard Crémazie aux "voies ferrées"

- Rue Jarry Est I: De la rue d'Iberville au boulevard Pie IX

- Rue Jarry Est II: Du boulevard Saint Laurent à l'avenue Papineau

- Rue Jean Talon Est: De l'avenue Papineau à la rue de Lorimier

- Rue Jean Talon Ouest: Du boulevard de l'Acadie à la rue Hutchinson

- Rue Saint Hubert: De la rue Jean Talon à la rue du Rosaire