

**THE SKYTRAIN AS AN EXPORTER OF CRIME?
EXPLORING THE SPATIAL DISTRIBUTION OF CRIME
ON THE CANADA LINE**

by

Jordana Kimberly Gallison
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APPROVAL

Name: **Jordana Kimberly Gallison**
Degree: **Master of Arts**
Title of Thesis: **The SkyTrain as an exporter of crime? Exploring the spatial distribution of crime on the Canada Line**

Examining Committee:

Chair: **Dr. William Glackman**
Associate Professor and Graduate Program Director

Dr. Martin Andresen
Senior Supervisor
Assistant Professor, School of Criminology

Dr. Bryan Kinney
Supervisor
Associate Professor, School of Criminology

Dr. Greg Jenion
External Examiner
Faculty, Kwantlen Polytechnic University

Date Defended/Approved: May 29th, 2012

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ABSTRACT

The Canada Line is the most recent expansion of Metro Vancouver's SkyTrain system. The implementation of the new mass transit route aroused many concerns and fears that the expansion of the SkyTrain would facilitate a greater number of crimes occurring to the stations and cities that host the new line. The following study was conducted to determine whether such fears of transit expansion and crime growth could be validated. This study offers a preliminary evaluation of the impact upon crime at seven stations along the Canada Line. Time series techniques were used to analyze crime data from the Richmond detachment of the Royal Canadian Mounted Police (RCMP) from January 2006 to August 2011. Results of the study are considered in relation to a number of various factors influencing both the type and geographical location of the region. The study illustrates the importance of considering the relationship between crime, land use and transit systems.

Keywords: Crime; Canada Line; SkyTrain; Mass Transit; Land Use

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GLOSSARY

Canada Line: Vancouver's third SkyTrain Line

CCTV: Closed Circuit Television Camera

CLRT: Canada Line Rapid Transit

CPTED: Crime Prevention through Environmental Design

Green Line: Los Angeles' Light Rail System

LAPD: Los Angeles Police Department

MARTA: Metropolitan Atlanta Transit Authority

Meteor: Paris' Subway Line

Metro DC: Washington DC's Subway System

Metro Paris: Paris' Subway Line

MTR: Hong Kong's Subway System

NYCTA: New York City Transit Authority

PRIME: Police Records Information Management Environment

PTC: Australian Public Transport Corporation

RAV: Richmond-Airport-Vancouver Line

RCMP: Royal Canadian Mounted Police

SCRTD: Southern California Rapid Transit District of Los Angeles

SkyTrain: Vancouver's Light Rail System

TransLink: Metro Vancouver's BC Transportation Authority

TVM: Ticketing Vending Machine

UCR: Uniform Crime Reporting System

Underground: London's Subway System

UTS: Underground ticketing systems

YVR: Vancouver International Airport

1: INTRODUCTION

The expansion of cities necessitates the growth and extension of public transportation. As transit routes continue to expand outward to the periphery of cities and suburban neighbourhoods, so does the level of resistance to implement such routes. Resistance is often based on the common perception that new transit routes facilitate the growth of crime within communities and neighbourhoods adjacent to the new transit station(s). The question becomes, does a transit line bring crime to neighbourhoods nearby to its transit stop(s)? and furthermore, do mass transit systems export crime to suburban neighbourhoods?

Loukaitou-Sideris, Liggett & Iseki (2002) argue that in determining whether or not public transportation facilitates crime, one must first consider why transit routes and stations attract crime. Public settings such as transit stations tend to attract and generate crime due to their ability to gather large crowds of people travelling to work, shopping or recreation along a limited number of pathways (Brantingham, Brantingham & Wong, 1991; Felson, Dickman, Glenn, Kelly, Lambard, Maher, Nelson-Green, Ortega, Preiser, Rajedran, Ross, Tous & Veil, 1990; Loukaitou-Sideris et al., 2002). Myhre & Rosso (1996) argue that transit stations are especially susceptible to crime with the large number of potential targets available for offenders to victimize. Commuters represent an easy target for an offender to commit a crime against; most commuters are tired, preoccupied and usually tend to carry purses, bags and other packages with small but valuable objects within them (Myhre & Rosso, 1996). With such ample targets available to choose from, transit stations provide a favourable setting for offenders to seize upon criminal opportunities. Furthermore, aside from crime occurring at public transportation stations, mass transit systems have the potential to export crime from one area to another (Loukaitou-Sideris et al., 2002). Communities surrounding public transit stations are equally as vulnerable to experience an increase in the number of crimes committed within their particular neighbourhoods. Offenders, when travelling on mass public transportation systems, gain new access to communities never before accessible by public transit. New pathways can lead offenders to seek out more alluring targets as

they become more familiar with the neighbourhood. Poister (1996) undertook a study in Atlanta, GA that demonstrated the mobility of offenders. The creation of a new line on the MARTA system in Atlanta showed how new pathways were utilized by offenders in order to reach suburban neighbourhoods farther away from metropolis city centres.

The field of offender mobility and public transportation is under-examined. Past attempts to study public transportation and crime have almost exclusively focused on the structural design of transit stations while examining the different types of transit crime committed (Felson et al., 1996; La Vigne, 1996; Myhre & Rosso, 1996; Smith & Clarke, 2000). Studies that have focused on offender mobility and public transportation have provided some preliminary results in this complex relationship between public transport and crime (Pearlstein & Wachs, 1982; Poister, 1996; Loukaitou-Sideris, 2002). Results from such studies demonstrate that there is a marked, visible increase in the number of crimes that occur after the implementation of a new public transport route. However, the studies do not demonstrate the long term effect public transportation routes and stations can have on nearby community crime rates.

As such, it is important to study public transportation as a potential exporter of crime. Transit crime affects people's decisions to use public transit and can cause a loss in ridership and revenue generated from transit fare. Such losses threaten the long-term viability of metropolitan areas, imposing limitations on the growth of transit systems and the ability for cities to evolve (Poister, 1996). Therefore, it is essential to consider the role of the urban landscape in relation to crime.

The aim of the present study is to determine whether or not the expansion of public transportation routes facilitates a greater number of crimes within the city and adjacent communities. The study focuses on Vancouver's rapid transit system, the SkyTrain, and in particular the Canada Line. The Canada Line was implemented in 2009, and faced resistance, due to concerns surrounding construction and the fear of spreading crime to nearby residences and commercial businesses (City of Vancouver, 2005; Boei, 2006; Bennett, 2008). The cities of Vancouver and Richmond, British Columbia, host the Canada Line. The present study seeks to incorporate a spatial aspect to locate and witness crime trends within the city of Richmond from January 2006 to August 2011. Utilization of time series analyses and regression techniques are

applied to help identify and determine the impact the Canada Line has had on communities surrounding the new stations. This thesis demonstrates that the introduction of a new public transportation route may initially increase the crime rate but steadily declines once it has stabilized within the communities.

The first part of this thesis outlines the relevant theory and empirical research alongside the contextual history of the development of the Canada Line. Theoretical and empirical support demonstrates the importance of undertaking studies to understand the relationship between the spatial distribution of crime and public transportation. Furthermore, the research explains offender mobility and the level of criminal incidence surrounding public transit routes. The contextual history of the Canada Line establishes the need for focusing the study to Vancouver and Richmond, especially with events such as the Vancouver 2010 Winter Olympic Games that spurred the development of the Canada Line. The second half of this study focuses on the methodology used to facilitate the study while providing the results collected from the measurement techniques applied. The results demonstrate the statistical significance of applying such measures to the Canada Line and help validate the results collected. Concluding the research demonstrates the policy implications from such work and provides future direction for studies within the field of public transportation and crime.

2: THEORETICAL SUPPORT

2.1 Introduction

Historically, a number of theoretical approaches have sought to explain the occurrence of crime (Loukaitou-Sideris, Liggett & Iseki, 2002). Compositional theories of crime have focused on explaining the criminality of offenders. This can be achieved by studying the biological, psychological and social conditions of a criminal event (Paulsen & Robinson, 2009). Ecological theories of crime on the other hand, focus on the context in which a crime takes place. Such theories focus on determining where, when and how crime occurs (Brantingham & Brantingham, 1981). It is critical that criminologists use both compositional and ecological theories in the study of crime and public transportation. Without an offender, there can be no crime. However, without a place, an offender cannot commit a crime. Therefore, the utilization of both theories is applied to study the effects of public transit on crime through the study of environmental criminology.

The following sections provide both the historical development of environmental criminology as well as the theoretical basis that supports the relationship between offender mobility and public transportation. In particular, the study of three theoretical perspectives, Rational Choice Theory, Routine Activities Theory, and the Geometric Theory of Crime, are applied to the current analysis of the Canada Line. By applying criminological theory to the Canada Line, a greater understanding emerges to understand the frequency and distribution patterns of crime on different forms of mass public transportation.

2.2 Historical Development

Environmental theories of crime can be traced to the early 19th century through the work of Guerry (1833) and Quetelet (1832, 1842) using cartography. The French sociologists utilized shaded maps to help indicate and analyze regional differences in

both property and violent crime (Kooi, 2007). The work was also conducted to help determine and explain differences in violent and property crime based on varying social conditions of the residential population. Results demonstrated that crimes rates varied, but more importantly, were stable over long periods of time. The work undertaken by Guerry (1833) and Quetelet (1831, 1842) helped pioneer early work on the spatial distribution of crime.

Nearly a century later, the work of Shaw & McKay (1942) further explored the relationship between crime and geography. As some have suggested, *Juvenile Delinquency and Urban Areas*, Shaw & McKay (1942) sought to demonstrate how an ecological approach could be taken to understand the interaction between neighbourhood environments and crime (Kooi, 2007). Shaw and McKay were able to build upon the work of both Burgess (1925) and Park (1967) to demonstrate that concentric circles existed within the urban social structure of cities (such as Chicago). Furthermore, such circles were related to crime patterns. Results from the study indicated that neighbourhoods that suffered higher rates of crime were characterized as suffering from high residential turnover, high unemployment and low rates of home ownership (Shaw & McKay, 1942). Results also showed that central business districts within Chicago suffered the highest recorded level of crime compared to their suburban counterparts further away. The outcome of the study was critical for the development of crime and place, as it acknowledged that crime has geography (Andresen, 2006)¹.

The intellectual development of environmental criminology can be traced to the work of C. Ray Jeffery (1971) and Oscar Newman (1972). Jeffery first introduced the concept CPTED, otherwise known as Crime Prevention through Environmental Design in 1971. Using CPTED, Jeffery linked together both psychology and the physical environment to help promote an emphasis on crime prevention. Jeffery (1971) argued that an individual seeks cues from the physical environment in order to maximize pleasurable experiences while minimizing painful ones, similar to the work of social psychologist, B.F. Skinner (1963)². As an example, offenders seek out activities criminal

¹ Shaw & McKay's work was a clear empirical demonstration that crime was not tied to any one ethnic or racial group.

² C.Ray Jeffery attended Indiana University where B.F. Skinner was chair of the Psychology Department; thus, it is not surprising that Jeffery's work was influenced by Skinner.

in nature such as committing theft, damaging property and assaulting an individual. However, they must be cautious in committing such offences in order to avoid being detected, apprehended and punished for their criminal actions. Thus, the physical environment can help control behaviour based on the removal or reinforcement of criminal opportunities, therefore allowing practitioners to respond proactively to crime by trying to prevent crime before it occurs. Jeffery's approach can be seen as an advancement in the development and application of ecological models of crime because of his ability to relate human psychology and behaviour to the environment.

Emerging from the same perspective, Newman (1972) also contended that criminal opportunities could be decreased by altering the physical environment, an approach he called defensible space. Newman (1972) sought to demonstrate this concept through the establishment of four essential points in his work entitled, *Defensible Space: Crime Prevention through Urban Design*. He argued that an offender's behaviour is controlled by cues emitted from his or her surrounding environment. By employing principles he called, 'territoriality', 'surveillance', 'image' and 'milleu', together they could deter an offender from committing crime. Particular physical or built features of the architectural surroundings could suppress crime by increasing visibility of guardians, creating a better image of an area and having greater individual ownership to protect property. Newman (1972) argued that crime would be lower in areas characterized by these four elements of defensible space as opposed to areas that lacked such elements, as demonstrated in his studies of public housing complexes in New York. Both Jeffery (1971) and Newman (1972) demonstrated how criminal opportunities are shaped by changes made to our physical environment. Jeffery (1978) sums up the importance of considering the physical environment in relation to the number of crimes committed in various settings:

'Crime rates are highly correlated with the physical features of the environment, such as streets, parks, buildings, highways, and public transit. Most areas of the urban environment are crime-free; crime is very selective where it occurs. Some blocks have many murders and robberies, others have none. Crime prevention involves the design of physical space. This is a joining of urban design, environmental psychology and social ecology into a meaningful relationship.'
(Jeffery, 1978, p.160)

The relationship between urban design, environmental psychology and social ecology as expressed by Jeffery (1978) was further developed in the work of Brantingham & Brantingham (1981; 1991; 1993). Patricia Brantingham & Paul Brantingham were among the first theorists to study the interaction between offender behaviour, decision making and the environment. The authors studied the geographic patterns of burglary and formulated an explicitly spatial theory based on crime patterns. Specifically, the theory contends that offenders behave in a manner that is defined as both 'normal' and 'rational' as they work within a particular spatial and temporal framework of their normal daily activities. Individuals who travel throughout the day developmental maps, also known as awareness spaces, as they begin to formulate pathways between major points of interest within their routine (Brantingham & Brantingham, 1981). It is the travel between the major focal points that helps develop and refine an offender's awareness and familiarity of their surroundings. The work by Brantingham & Brantingham (1981) concluded that there is a link between both the routine activities of offenders and victims and social disorganization theory at a micro level of analysis.

Collectively, the evolution of environmental criminology demonstrates the ability for crime to occur in any setting, regardless of socio-demographic factors. It is important to understand the foundation of environmental theories of crime in order to comprehend the current analysis of public transportation and crime. In addition to environmental criminology, three other criminological theories of crime aim at providing further analysis of the Canada Line and its ability to make offenders mobile to commit crime. These theories include Routine Activities Theory, Rational Choice Theory and the Geometric Theory of Crime.

2.3 Environmental Theories

2.3.1 Rational Choice Theory

Rational Choice Theory was first developed by Ronald Clarke in an attempt to establish the importance of choice in the commission of crime (Clarke, 1977; 1980). Clarke refined his work of choice within his studies of situational crime prevention to

explore with Derek Cornish, how individuals respond to a variety of environments (Clarke, 1977; 1980). Together, Cornish and Clarke (1986) developed their theory of Rational Choice through examining the long term effects of institutional treatments on juvenile delinquents (Lersch, 2007). Conclusions drawn from Cornish & Clarke's observations indicated a marked contrast in the number of criminal opportunities available in a given environment. The question remained as to whether, a greater number of opportunities existed for both youth and adults to be more criminal in some environments than others, away from correctional facilities.

Refinement of their initial results led Cornish & Clarke to publish the *Reasoning Criminal* (1986) outlining the conscious decision making of offenders who choose to commit crime. The theory makes the assumption that an offender makes a 'rational' decision as to whether or not to commit a crime. An individual processes information emitted from both their physical and social environments (Cornish & Clarke, 1986). Influences include a wide spectrum of factors such as one's previous experiences and background, assessment of general needs, evaluation of real and perceived solutions, chance events, readiness and decisions. As such, a rational choice reflects the complexity of the decision making process an offender goes under in choosing to commit any action, not only actions deemed criminal.

The work of Cornish & Clarke (1986) parallels with earlier work conducted by Jeffery (1971) supporting the environment altering one's decisions to participate in criminal activity. According to Cornish and Clarke (1986), an individual will gauge his or her personal needs and wants with the risk of becoming apprehended, the severity of punishment as well as the gain earned from the commission of the offence. The offender will then react selectively to particular situational factors, or cues of the given environment to determine whether or not a target is worth pursuing (Lersch, 2007). Jeffery (1971) makes similar points in his early work of CPTED indicating that environments send cues to an individual and the individual will pursue cues that optimize pleasure while minimizing pain. An offender will choose cues that will provide his or her wants, avoid detection, and therefore avoiding punishment for an offence. An example could include an offender who views an empty house from a subway platform, breaks and enters without been seen into the house, flees without being apprehended (thus no punishment) and is able to leave with stolen goods from the house.

The decision making of individuals is not a simple choice whether to act upon an opportunity or not. Rather, individuals go under an intricate thought process of deciding whether or not to participate in crime. Furthermore, these individuals contemplate the consequences of those actions, regardless of whether they are positive or negative. Rational Choice Theory is a critical perspective to use in the current analysis of the Canada Line in Vancouver and Richmond. Potential offenders who use the Canada Line to travel to perform their daily routines may respond to criminal cues from the transit environment to commit crime. This can be in the form of searching or reacting to cues emitted from the SkyTrain stations themselves or from the surrounding neighbourhoods adjacent to the Canada Line. Regardless of which cues they respond to, offenders will have the rational decision making processes within them to commit crime or not. Rational Choice Theory is a resourceful perspective to apply to environmental criminology as it helps focus on the criminal event and situational factors that contribute to the commission of crime instead of offender characteristics alone (Lersch, 2007).

2.3.2 Routine Activities Theory

Lawrence Cohen & Marcus Felson first proposed Routine Activities Theory in an attempt to explain crime through the structural changes within the daily routines of offenders and victims (1979). From 1960 to 1975, the United States witnessed an unprecedented increase in crime. Forcible rape increased 174%, homicide increased 188%, burglary increased 200% and robbery increased 263% (Cohen & Felson, 1979). The most troubling aspect of the increase was the inability for socio-demographic factors to explain the change. Previous social conditions used to explain differing levels of crime such as employment, household income and education had improved during the same time period between 1960-1975, advancing cities and their surrounding metropolitan areas. Instead, Cohen & Felson (1979) analyzed the incompatible trends at a macro level analysis, looking to the structure of routine activities to provide insight into the growth of crime.

Cohen & Felson (1979) argued that in order to understand the change in the number of crimes committed in the United States, one must look to the changes in the

population's routine activities. Following World War II, where, when and how people conducted their daily activities differed from before the war. Instead of remaining close to home to go to work and school, more people began leaving their homes for longer periods of the day to pursue different activities. Activities could include going to work, attending school, and engaging in leisurely activities. More women pursued employment, more young adults obtained post secondary educations and the creation of more shopping centres and stores increased the likelihood of someone to feel compelled to pursue such activities (Cohen & Felson, 1979). By changing one's routine, the temporal and spatial patterns of interaction with different people increased the likelihood of becoming a victim of a crime themselves or having their property victimized against.

How could changes in the routines of a person affect the number of crimes? Cohen & Felson (1979) contended that when offenders and victims converged, the possibility for a crime increased. A perpetrator has the ability to intentionally take or harm a target through illegal activities. Such illegal activities are classified as 'direct contact predatory violations' (Cohen & Felson, 1979, p.589). In order for such violations to occur, Routine Activities Theory proposes that three minimal elements must be present in order for a crime to occur. Elements include a suitable target (a person or a piece of property), a motivated offender and a lack of a capable guardian (anyone who engages in protective behaviours for family, friends, strangers and property). The lack of any one of these elements is sufficient to thwart the successful completion of a crime. Cohen & Felson (1979) further state:

'The convergence in time and space of suitable targets and the absence of capable guardians may even lead to large increases in crime rates without necessarily requiring any increase in the structural conditions that motivate individuals to engage in crime'(Cohen & Felson, 1979, p.589)

Therefore, it is assumed that individuals whose routine activities are within or close to home have a lower risk of certain forms of victimization (Andresen, 2006). This is a result of a higher level of guardianship over one's home. Therefore, regardless of one leaving the home in order to go to work, school, or shop, the act of leaving the protective

environment of home places one in harm's way or allows one to victimize against someone else (Andresen, 2006).

The combination of a motivated offender, a lack of a capable guardian and a suitable target occurs in transit environments. However, it is unclear whether or not the same level of mobility exists for offenders on different forms of public transportation. Placed in the context of the Canada Line, one could argue based on theoretical justification alone, that the convergence of targets and offenders on the SkyTrain combined with a lack of protection from capable guardians could result in a potential increase in the number of crimes within the surrounding neighbourhood. Offenders can travel to different SkyTrain stations along the Canada Line to pursue targets, both people and property, and commit crime. It is extremely important then, that the consideration and application of Routine Activities Theory be integrated into an empirical study of the Canada Line, as it provides support to both the motivation and context of whether or not crimes are committed along major public transportation routes.

2.3.3 Geometric Theory of Crime

The Geometric Theory of Crime is a theoretical approach explaining criminality through the criminal event. Brantingham & Brantingham (1981) contend that often there is a tendency to equate criminality with crime, regardless of the fact that criminality is a mere aspect of the criminal event. Instead, there are many elements that comprise of a criminal event. A criminal event involves looking at several factors to explain why a crime would occur. Often, consideration of the routine activities of both the offender and the victim are considered alongside the decision making of the offender. However, what the Geometric Theory of Crime offers is an additional element to the criminal event. Geometric Theory of Crime proposes that crime occurs as a result of templates that both offenders and victims use throughout the daily routines, a template that creates one's awareness space.

Awareness spaces are a mental framework of one's surrounding environment. Individuals create awareness spaces to travel to and from areas where they spend the majority of their time. Brantingham & Brantingham (1993) demonstrate that an awareness space comprises of three essential elements: nodes, pathways and edges. Nodes can be best described as areas where an individual spends a vast majority of

their time at. Such areas can include one's home, place of employment, areas of recreation and shopping, as well as school. The authors state that crime tends to occur within and around nodes due to the convergence of offenders and victims sharing the same use of space. Brantingham & Brantingham (1993) state that thousands of people share the same nodes, such as shopping at the same malls, working in the same office buildings and change buses at the same bus loops. Therefore, such nodes have the ability to attract crime. Pathways are the routes between an individual or a group's various activity nodes. As a consequence of the way the physical environment is shaped within urban centres, most pathways are channelled by major transportation routes such as main roads, highways, and public transportation routes. Many crimes cluster along or close to these major paths. Clustering tends to occur due to the volume of non-offenders and offenders converging in the same time and space, resulting in a larger number of crimes found within such areas (Brantingham & Brantingham, 1981).

Lastly, edges are defined as places where there is a distinction from one area to another, that a change is identifiable (Brantingham & Brantingham, 1981). Edges can take on both physical and perceptual forms. Physical edges include geographical borders, such as where land meets water, or when a road is used as a boundary between two different cities. They are easily identifiable as one notices a change immediately. Perceptual edges are harder to determine, as they are subjective in nature. Perceptual edges rest on social boundaries, such as when one enters a lower income slum compared to a wealthy neighbourhood.

When combined together, nodes, pathways and edges form the basis for one's awareness space. A potential offender will conduct a primary search for criminal opportunities based on their own experiences and familiarities within the surrounding environment. Often times, it is said that one's awareness space overlaps with their activity space (Andresen, Kinney, & Brantingham, 2010). These areas overlap with high intensity because offenders will search areas immediate to themselves rather than pursue targets at a further distance. It is often difficult based on these activity patterns to single out offenders, as they easily blend in and become part of the same environments shared by non-offenders. As a result, offenders do not appear to be "outsiders" and can exercise their criminal motivations without a high likelihood of being detected.

The Geometric Theory of Crime is an additional theoretical framework to use in the study of the Canada Line. In the context of the Canada Line, it is easily identifiable how the SkyTrain can serve to facilitate crime through the movements of offenders. Potential offenders who use the Canada Line to seek out criminal activities can expand their awareness spaces by using new pathways to reach different targets, often found at different activity nodes. An offender does not have to be limited to his or her own immediate environment, as the ease and accessibility provided by the Canada Line, can lead offenders to a new community to choose targets from, whether targets reside in the city of Vancouver or Richmond. Other activity nodes that were previously once difficult to reach can now be easily accessible and could provide the foundation for crime to increase in those areas marked by an increase in pathway accessibility. Furthermore, as will be shown, the Canada Line has unintentionally created new physical and perceptual edges. Riders will sense a change in familiarity as they leave one station to the next, as for instance, leaving Marine Drive Station in Vancouver and crossing the Fraser River into Richmond to Bridgeport Station.

2.4 Conclusion

Mass public transportation brings people together that would not normally come into contact with one another (Brantingham & Brantingham, 1998). Due to this convergence, there is an increase in the number of suitable targets available for a motivated offender to choose from to victimize against. Thus, it is important that opportunity and spatial theories of crime be discussed to help create and support various forms of crime on different settings of public transit.

As witnessed in the above discussion of environmental theories of crime, the environment plays a pivotal role shaping future crime patterns in Metro Vancouver. By integrating both the historical development and relevant criminological theory, our discussion demonstrates the merits of environmental criminology in the study of offender mobility and crime on different settings of public transportation. To further demonstrate the importance of public transportation to the study of crime and offender mobility, an empirical review of past criminological studies of transit crime will be reviewed.

3: EMPIRICAL RESEARCH

3.1 Introduction

Many suburban communities resist the expansion of mass public transit systems. Opposition stems from the perception that mass transit systems have the ability to increase crime by providing accessibility to communities located away from the inner core of a metropolis centre (Liggett et al., 2003). Block & Block (2000) contend that a dual relationship exists between transit crime and the environment that may give rise to the perception that transit increases crime. The authors argue that the socio-physical characteristics (such as household income and housing type) of the immediate station area affect the level of dangerousness at a transit station. Furthermore, the presence of a station affects the danger in the immediate neighbourhood (Block & Block, 2000). Liggett et al. (2003) argue that transit systems alone can compress the required amount of time necessary for a criminal to reach his or her destination. Brantingham & Brantingham (1981) further contribute that the concentration of criminal activities tends to occur close to major transportation arteries. Thus, perceptions that transit systems can increase crime may be true.

Criminological theory has demonstrated that transit lines and systems have the potential to expand a criminal's range of actions to commit crime (Cornish & Clarke, 1986; Cohen & Felson, 1979; Brantingham & Brantingham, 1981). However, a limited amount of empirical research has been conducted to validate the perception that public transit facilitates crime through accessibility to new targets within and surrounding the new station(s) (Poister, 1996). The following section explores studies that have studied various aspects of public transit and crime, such as types of transit crime, transit design and the distribution of crime. It is vital to examine which factors contribute to an increase in crime surrounding transit systems. Such factors have the ability to increase fear, prevent transit expansion and lead to an overall decrease in the level of ridership on transit systems, factors that can inhibit a city's growth.

3.2 Types of Transit Crime

Criminal opportunities are abundant within environments that host public transportation. Often, a wide range of opportunities exist that can facilitate or impede the development of crime. Smith & Clarke (2000) suggest that a variety of crimes occur within the environment of public transit. Crimes include vandalism & graffiti, fare evasion, theft, assault and over-charging of tickets. Such targets present ideal criminal opportunities as they are often stationary and unguarded (Smith & Clarke, 2000). Smith & Cornish (2006) argue that the public transit environment is particularly conducive to crime as such areas host a large volume of overcrowding during peak periods of travel and have a lack of supervision from transit staff. A further analysis of transit targets helps reveal why particular targets are repeatedly victimized within and surrounding transit systems.

3.2.1 Crimes against persons

Beller, Gareluk & Cooper (1980) undertook an exploratory study to understand the nature and frequency of non-felonious sex crimes³ on the New York City subway system. Beller et al. (1980) argue that the convergence of large, shifting, distracted populations of riders present many opportunities for offenders to commit crime. Offenders can easily make physical contact with another commuter due to the limited space and convergence of commuters in a short span of time. Women in particular are targeted in such situations as they are often found alone and pre-occupied as they wait to travel to work or home (Beller et al., 1980). The authors further argue that even particular stations can increase the probability of a non-felonious sexual assault. Stations that have more interconnecting transit lines, have mezzanines and transfer points provide more criminal opportunities for sexual offenders to commit crime than stations that are smaller and host only one line (Beller et al., 1980).

To determine the nature of sexual assault crimes within the New York City Subway Station, Beller et al. (1980) collected data from an 18 month period from January 1st, 1977 to June 30th, 1978 on all New York City subway sex offenders.

³ Non-felonious sex crimes are defined according to the New York Penal Code of 1967 as crimes of sexual abuse (i.e. physical molestation involving some kind of contact but without serious injury) and public lewdness (i.e. exposure or genital exhibitionism).

Information was also gathered on the victim's physical appearance to determine whether or not a victimology could be produced alongside an offender profile. Results indicated that sex offenders who committed a crime on the subway system tend to be between the ages of 20 to 40 years old. African Americans and Hispanics represented 45.8% and 37.7% of the data set, while Caucasians and other minority groups accounted for 22.8% and 1.7% of the sample. A difference did exist among types of sexual offenders. Beller et al. (1980) categorized sexual offenders into two subsets: Sexual abusers and Public lewdness offenders. Sexual abusers were more likely to be married (51.5%) as well as be employed (65.4%) than public lewdness offenders arrested during the same time period. Furthermore, 17.4% of sexual abusers were under the age of 20 while only 8.6% were in the same age range for public lewdness offenders (Beller et al., 1980).

Victims of sexual crimes on the subway system were primarily Caucasian, young, and were deemed 'ordinary' within their looks. Most of the victims were accosted by strangers, a trait that Beller et al. (1980) deems to be a unique characteristic to subway crime opposed to crime on the street-level. The authors have deemed such characteristics as 'tunnel mentality'. Unlike other serious crime such as physical assault, larceny and murder, sexual crimes such as sexual abuse and public lewdness are uniquely noted for their stranger oriented relationship, where the victim is at most known to the offender by sight from within the station than from previous acquaintance. Overall, the study provides important insight into the differences of the spatial location of sexual offences on the New York City subway system.

Clarke, Belanger & Eastman (1996) examined the relationship between passenger densities and robbery on New York's subway system. New York's subway system hosts 469 stations that serve 3.5 million passengers daily. Of the 469 stations, 277 stations are located underground while the remaining 192 are elevated (Clarke et al., 1996). The authors sought to determine whether robberies were more likely to occur when there was more pedestrian traffic on both the subway trains and their platforms.

Of the 469 stations, 57 stations were excluded from the study due to a lack of sufficient data regarding passenger densities from the New York City Transit Authority (NYCTA). A random sample of 50% (N=206) was drawn from the remaining 412 stations by including every other station on each of the 25 lines (Clarke et al., 1996).

Robbery data was collected during a 30 month period, from August 1992 to January 1995. Robbery was operationalized as the use or threat of force to steal property (Clarke et al., 1996). Robbery offences that occurred on moving subway trains (without a reported location), stairways, mezzanines or token booths were excluded from the study in order to maximize specification, resulting in 1492 offences on platforms.

Passenger density data was collected from the NYCTA that consisted of hourly counts of the number of people entering and exiting any given station on the subway system.

Clarke et al. (1996) selected data from 1989 as it represented a normal distribution of ridership than years such as 1991 and 1994 as they experienced both extreme highs and lows, factors that may have skewed the results of the study. Data for passenger densities were categorized into three groups: low, medium and high-density stations to determine which types of stations were victimized the greatest in terms of robbery.

Results demonstrate that the mean robbery risk for low-density stations was 1.36 per 1000 passengers. Medium-density risk was assessed for 0.63 per 1000 passengers while high-density stations were 0.26 per 1000 passengers. Thus, robbery risk has an inverse relationship with the number of passengers, indicating the probability of being victimized through means of robbery is greatest with fewer passengers around (Clarke et al., 1996). Data also indicated that robbery rates were highest on subway platforms between 9:00 pm and 5:00 am due to the fewer number of people travelling during this time period. Victims of robbery projected a profile of a young male with an increased probability of being intoxicated commuting away from the inner downtown core and entertainment corridor (Clarke et al., 1996). The authors conclude that station robbery rates are inversely correlated with passenger densities and such crimes are a result of available opportunities within a confined space.

3.2.2 Crimes against Property

Vandalism & Graffiti

Carr & Spring (1993) sought to study how graffiti and vandalism can impact the perception of fear on public transit within Victoria, Australia. The authors examined the effectiveness of implementing safety programs to different modes of public transportation to reduce the amount of vandalism and graffiti. Travel Safe was implemented in 1990 as

a safety initiative to increase passenger safety on public transit (Carr & Spring, 1993). The initiative was created due to a concern about the number of crimes against passengers and stations, approximately 690 crimes reported in 1990. This statistic is low given the context that more than 300 million passenger journeys were made during that same time period (Carr & Spring, 1993). However, it was the perception of crime and thus, fear of crime that posed a greater concern for public transit authorities. Despite the low statistics of crimes against passengers, people felt the current transit system posed a threat for commuters to be victimized by crime. Factors contributing to the increased fear included the physical condition of vehicles, stations and bus stops, graffiti, exposure to intimidating groups (rowdy and offensive youth) and the role of the media in over-stating incidents which occurred on public transit (Carr & Spring, 1993).

To counter-attack factors contributing to passenger fear of crime, the Australian Public Transport Corporation (PTC) implemented the Travel Safe Program. The program helped identify to passengers and the community the new safety initiatives being taken by the PTC to create a safer transit environment. Such measures included the swift removal of graffiti and reparation of vandalism, installation of public telephones, improved lighting, enhanced police presence, and the installation of closed-circuit television (CCTV) cameras (Carr & Spring, 1993). Additional measures also included improving community input and involvement with projects involving transit and establishing a greater link between researchers within the field of graffiti and vandalism and the PTC (Carr & Spring, 1993).

Results of the initiative witnessed a reduction of crimes against person on public transit by 42% over a period of 2 years. Between 1989 and 1990, an average of 57 incidents occurred monthly whereas between 1991 and 1992, the number of incidents reduced to an average of 33 monthly (Carr & Spring, 1993). The physical condition of trains, buses and stations also improved. Fewer vehicle windows were damaged, the level of graffiti and vandalism decreased as well. The authors conclude that the Travel Safe program can be contributed to improving both the security and perception of crime on Victoria's public transportation system in Australia.

Loukaitou-Sideris, Liggett, Iseki & Thurlow (2001) studied the effects of the built environment on bus stop crime. The authors argued that bus stops provide offenders

with different opportunities to commit crime, as they can linger searching for victims without arousing suspicion. Furthermore, bus stops are often characterized by the level of "physical disrepair and deterioration" (Loukaitou-Sideris et al., 2001, p.258). Physical incivilities such as trash, graffiti and vandalism can result in higher levels of crime as well as a marked increase in resident fear. Referring to Wilson and Kelling's (1982) theory of broken windows, potential offenders are more likely to commit crime due to the belief that social control is weak and therefore they can commit crime without concern.

The study looked at various aspects of crime, drawing from both public nuisance offences, such as graffiti, vandalism and public intoxication, and crimes against the person offences such as physical and sexual assault and robbery. Loukaitou-Sideris et al. (2001) utilized crime data from the Los Angeles County Metropolitan Transportation Authority (MTA) between January 1994 and December 1995. Data included the type of crime that was committed and the time and day in which the offence took place. Due to the nature of how each crime was recorded, intersections (N=60) served as the unit of analysis rather than the individual bus stops themselves. Locations of crimes were recorded by street address or closest intersection. Therefore, one cannot distinguish at which individual bus stops the crime occurred. Lastly, victims were identified as individuals who had been waiting for a bus or who had just exited out of a bus.

The total number of bus stop crimes for the 60 intersections resulted in 1480, with over 95% accounting for public nuisance crimes (Loukaitou-Sideris et al., 2001). Focusing on vandalism and graffiti alone, Loukaitou-Sideris et al. (2001) assigned values to each intersection to determine the level of vandalism and graffiti present. Values included 0 for no graffiti or vandalism present, 1 for a little, 2 for some and 3 for plenty. Intersections could score a maximum of 48 (accounting for segments within each intersection). Results demonstrated that scores ranged from 0 to 31, indicating a weak to moderate correlation between graffiti and litter and the crime rate. When intersections were categorized as either low graffiti and litter areas or moderate to higher graffiti and litter areas, Loukaitou-Sideris et al. (2001) found significantly higher numbers of crimes per 100 riders at intersections with moderate to high amounts of graffiti and litter. The results reveal that the presence of graffiti and litter tend to increase the level of crime in an area than those areas that do not have graffiti or litter present.

Fare Evasion

Clarke (1993) examined the effectiveness of installing underground ticketing systems (UTS) in London's Underground subway system to reduce the level of fare evasion. London's Underground subway system is one of the largest mass transit systems, hosting 272 stations and serving 2.5 million people daily (Clarke, 1993). The collection of fare was conducted through an honour system where tickets were purchased from booking officers or free standing machines that sold daily or seasonal tickets to passengers (Clarke, 1993). However, the system was extremely vulnerable to fare evasion, where in 1987, the reported loss of revenue from fare evasion reached a sum of approximately £25 million (Clarke, 1993).

A modified UTS system was implemented in April of 1987 but did not become fully operational until the end of 1989. Authorities sought to combat the level of fare evasion through the implementation of magnetically encoded tickets. Tickets must pass through both an entry and exit point within a given station. Clarke (1993) sought to study the impact the adapted UTS system had on fare evasion, by comparing the levels of fare evasion before and after the implementation of the new UTS system.

Clarke (1993) conducted 2 separate analyses of the effect of the UTS system on fare evasion. The first analysis examined the results of annual fare evasion surveys conducted by the Underground for a period of time spanning the introduction of the UTS. Surveys were conducted for a 2 week period in October (as well as March in 1989) that examined approximately 12,500 tickets of passengers commuting along the Underground. Tickets were examined by small teams of London Underground staff who would board train cars within specific geographical and time boundaries. A quota sampling technique was implemented to ensure equal probability of train cars being selected. Data collected described the details of the ticket and the stated journey of the passenger recorded. The number of passengers checked without a valid ticket was compared with the total number of passengers checked on the car. Results of the surveys demonstrated that the level of fare evasion decreased from 6.3% recorded in 1982 to 1.9% by 1990, suggesting the UTS has been effective in reducing fare evasion. Furthermore, £30 million was lost in 1989 through fare evasion while figures in 1990 demonstrate a decrease to £10 million.

The second analysis sought to determine the impact of implementing automatic gates on fare evasion. Stockwell and Brixton were stations selected for the installation of automatic gates as both suffered from a higher rate of fare evasion than other suburban stations (located outside of the Central Zone). Gates were implemented in December of 1991. Examination of ticket sales were conducted in 2 randomly selected weeks: the first week in October (prior to the gates) and the second week in January, one month after the implementation of the gates (Clarke, 1993). Results from the ticket patterns illustrate an increase in the number of tickets purchased, with Brixton witnessing an increase of 12.9% in ordinary tickets and 85.3% in excess tickets and Stockwell experiencing smaller increases of 9.0% in ordinary tickets and 57.3% in excess tickets (Clarke, 1993). These results indicate that the automatic gates were effective in reducing fare evasion and increasing transit revenue. Clarke (1993) concludes that the spending of £165 million on the UTS system has saved the London Underground system £20 million within its first year of operation and will recover costs within the first 2 to 3 years of operation.

Weidner (1996) also conducted an evaluation of the effectiveness of turnstiles in order to reduce the level of fare evasion on New York's subway system. Weidner (1996) contended that subway stations that had turnstiles would report lower levels of fare evasion compared to the stations without any turnstiles. To validate Weidner's hypothesis, high wheel turnstiles (floor to ceiling) were implemented at 110th station, while 103rd and 116th stations were used as comparison groups to demonstrate a possible change. The study was conducted from May 1989 to April 1994, a total of 60 months. Turnstiles were implemented at 110th station in May of 1991, allowing Weidner (1996) to capture pre and post intervention changes. To enhance the results of the study, several other forms of data were utilized to support the research being undertaken. Data were collected monthly from NYCTA, denoting the number of fare evasion arrests made, the number of summons issued to fare evaders as well as the level of ridership measured from the turnstiles (Clarke, 1993). Furthermore, a survey was administered in 1992 by a policy research division of the NYCTA which measured reactions of passengers (N=380) from the 110th street station to the implementation of the turnstiles.

Results indicated that the 110th station witnessed a decrease in the level of arrests and summons issued for fare evasion, when compared to the 103rd and 116th subway stations (Weidner, 1996). The decrease suggests that the reduction can be attributed to the implementation of the turnstiles. An additional benefit arising from the turnstiles is a reduced need to deploy law enforcement and ticket clerks to monitor and issue tickets to passengers, leading to a reduction of costs to the NYCTA (Weidner, 1996). Results from the survey indicated the turnstiles helped enhance feelings of safety amongst passengers (51%). However, 44% of passengers disapproved of the new feature as it was blamed for long queues and missing trains which inconvenienced many passengers. The study demonstrates that despite some disapproving attitudes from some of the public, the turnstiles helped reduce fare evasion while increasing feelings of passenger safety.

3.3 Transit Design

Buses

Felson, Belanger, Bichler, Bruzinski, Campbell, Fried, Grofik, Mazur, O'Regan, Sweeney, Ullman & Williams (1996) sought to determine whether physical modifications to New York City's Port Authority Bus Terminal impacted the rate of crime and deviance. The objective of the study was to demonstrate that the removal and reduction of types of crime and social disorder could be achieved through the application of CPTED principles to the bus depot. In particular, Felson et al. (1996) sought to reduce crimes such as robbery, theft and assault at the depot. Social disorder issues targeted included reducing the number of homeless people lingering around the station, lowering the number of drug sales, decreasing solicitation for prostitution and removing litter to help minimize passenger fear of crime.

Several techniques were applied during 1991 and 1992 to help improve the image of the bus depot. CPTED principles applied included the implementation of better lighting, improving the visibility of signs and walls, and the removal of several obstructive walls, niches and corners. To further improve the perception of safety within the depot, transit authorities deployed more staff to routinely walk around the depot during off-peak hours of service to create the illusion of the depot appearing busy (Felson et al., 1996).

With more movement, passengers felt less likely to experience vulnerability from becoming a victim of crime.

Results drawn from the study demonstrate the ability to reduce fear of the depot through simple structural modifications to the bus depot. In addition, physical modifications to the depot helped the bus depot decrease its ability to generate and attract crime. Displacement was tested for but could not be identified to areas located near the bus depot. Singular techniques could not be attributed to any given decrease as multiple techniques were employed simultaneously. Felson et al. (1996) suggest that despite the physical changes to the depot, crime and deviance is a result of human behaviour and mobility patterns. Movement through the depot is driven from cues emitted from the environment. Thus, authorities must ensure paths are streamlined, movement and flows of people are sped up and evened out, and main pathways filled with legitimate activities in order to discourage offenders from acting upon criminal opportunities within the transit environment.

Subways

Gaylord & Galliher (1991) sought to explain the low occurrence of crime on Hong Kong's mass transit system, the MTR. Unlike subway stations such as New York, Chicago and London, Hong Kong's MTR subway system has one of the lowest rates of crime despite having one of the world's largest population densities (Gaylord & Galliher, 1991). The MTR consists of 3 lines that hosts 38 stations. On average, 1.9 million passengers ride the MTR daily. It is estimated that roughly 80% of the Hong Kong population uses the MTR as their main mode of travelling. The authors sought to conduct a study to help identify which factors were responsible for the MTR's low crime rate given this uncommon phenomenon occurring.

A multitude of data sources were utilized and applied to the 5 month study of the MTR. Sources included interviews with the MTR District Police, MTR Corporation personnel, Hong Kong government officials, academics, passengers of the MTR, official crime statistics, crime victimization surveys, media reports and direct observations in the field of the MTR.

Results indicated a number of factors that contributed to the low crime rate within the MTR. Policing was one of the most important factors in the reduction of crime. Police are dispatched to every station in order to ensure fast response times when calls of assistance are made. Furthermore, MTR police tend to fall into a young demographic. New officers are anxious to leave the underground setting and to assist with more challenging work above on the street level. Thus, MTR officers will work extremely hard to ensure that they have the possibility of a promotion. Furthermore, all officers are highly trained in areas such as crowd and riot control. Together, such aspects help make the MTR police both skilful and efficient in preventing crime from occurring at the stations of the MTR.

A secondary factor which contributed to the low level of crime was the design and construction of the MTR. The MTR was built upon the principle of "design out", where the alterations to the physical environment could control for the number of criminal opportunities available for possible offenders to act upon (Gaylord & Galliher, 1991). This premise is highly related to the principles of Jeffery's CPTED (1971). Urban planners of the MTR sought to several other subway systems such as London's, New York's and Tokyo's subway systems in order replicate past achievements and improve upon past failures. Techniques employed included higher levels of communication between train operators, police and passengers, elimination of hidden corridors and walls, installation of mirrors to increase visibility, CCTV monitors and the removal of public chairs, benches, washrooms, fast food restaurants and luggage lockers in order to discourage loitering. Lighting was also implemented to increase visibility as well as decreasing the number of available entrances and exits into the subway stations and platforms. Exact fare systems were also implemented to deter fare evaders.

Overall, Gaylord & Galliher (1991) assert that through the use of effective police deployment and structural changes to the subway, the MTR provides a safe environment in which criminal opportunities are difficult to seek and act upon. Through careful consideration, implementation of simple structural changes can prevent mass concentrations of people from being victimized by potential offenders in transit environments.

La Vigne (1996) undertook a study to examine the effectiveness of employing crime prevention techniques to Washington DC's subway station, the Metro. Similar to Hong Kong's MTR, Washington DC's Metro had an unusually low crime rate (La Vigne, 1996). Many have argued that the low crime rate can be attributed to the architectural design of the Metro's stations, principles that are reflective of CPTED. In order to validate this perception, La Vigne (1996) posed 2 questions. First, is the Metro safer than one would expect, given the incidence and prevalence of crime on other subway systems and crime occurring in communities that the Metro serves? Second, is the Metro's unusually low crime rate explained by its environment, in the way the system is designed, managed and maintained?

In order to determine if the Metro's crime rate was unusually low, the subway system was compared to 3 other subway systems within the United States; Atlanta, Chicago and Boston. Results indicated that crime on the Metro was significantly lower than the 3 other lines studied (La Vigne, 1996). Thus, the author contributes the low crime rate to the environment in which the system is implemented as a reason for the low level of crime. Furthermore, the other 3 lines studied were constructed prior to safety considerations, providing more support for the low occurrence of crime at the Metro (La Vigne, 1996).

A further analysis was conducted to answer La Vigne's (1996) second research question, determining whether the low crime rate is attributed to the structural design and maintenance of the Metro. During the construction of the Metro, deterrence was a major operational goal of urban planners. Planners utilized techniques into the subway stations based on previous experience in increasing safety within public transit stations. CPTED principles from Jeffery (1971) indicate a similarity but were not purposely applied to the Metro.

Features that were found to impact the level of crime included the position of platforms, elevated or submerged, length of elevators, and whether a station served as a transfer point to another transit line (La Vigne, 1996). CPTED-like techniques that helped collectively reduce crime included the limited number of entrances and exits, improved lighting, implementation of CCTV cameras, increased number of signage, and exact fare systems (La Vigne, 1996). Together, such features helped reduce loitering

and increase visibility within the Metro stations that prevented criminal opportunities from arising. Overall, the low levels of reported crime within the Metro demonstrate the impact of implementing structural changes to the physical rather than social environment to prevent crime on different modes of public transit.

Myhre & Rosso (1996) also studied the effectiveness of employing situational crime prevention techniques to the subway system in Paris, France. The aim of the study was to demonstrate how Paris' new transit line, the Meteor, could incorporate preventive measures to reduce crime on the subway system. Myhre & Rosso (1996) studied and compared multiple subway systems to determine whether the application of CPTED principles helped improve safety and prevent crime from occurring. Washington DC's Metro and Hong Kong's MTR were proven to be successful in reducing crime as both systems were designed with crime prevention in mind. The study of Paris' other transit line, the Metro, demonstrated how a system without consideration of crime prevention serves to facilitate crime. The Metro in Paris was found to have increased loitering, a lack of surveillance and visibility, factors that all contribute to an increase in criminal opportunities available within a transit station.

Myhre & Rosso (1996) further applied their analysis of subway stations to the Meteor. Results of their analysis demonstrate that Myhre & Rosso (1996) identified several crime prevention techniques utilized within the Meteor that were found in both Washington and Hong Kong. Such features include increased surveillance (more police foot patrols and better lighting) and a limited number of entrances, exits and pathways that prevented spaces for potential offenders to utilize. The study indicates that the Meteor line contains several improvements from the pre-existing line, the Metro in Paris (Myhre & Rosso, 1996). Additionally, simple design elements can vastly improve the number of criminal opportunities available within a transit station. Improving visibility and directionality has proven to be most appropriate in transit environments.

3.4 Distribution of Crime on transit

Capone (1976) sought to explore the relationship between offender mobility and the urban landscape. According to the author, the structure of an urban city provides considerable insight into the spatial distribution of crime (Capone, 1976). Offenders are constrained by the number of criminal opportunities within any given environment, thus,

by understanding how the urban structure of cities works, one can understand how offenders make decisions. Capone (1976) sought to determine the distance biases of robbery offenders within Miami, Florida to demonstrate that individual offender behaviour is related to the movement of Miami's urban system. As well, the frequency of robbery trips within urban spaces declines with increasing distance from the residential location of offenders.

Data was collected in 825 robbery trips (642 cleared robberies) within Miami, Florida in 1971. Data was drawn from Dade County's police records, representing both the urban core and suburban neighbourhoods. Trip distances to commit robbery were calculated for all 825 offenders through plotting the origin of the trip (location of residence) and the destination (location of occurrence). Results demonstrated that trip frequency declines dramatically with distance, with 33% of all robbery trips occurring within one mile of the offender's residence. Capone (1976) found that premises such as liquor stores, super markets and loan companies showed that offenders were more likely to make lengthy trip distances opposed to residences, grocery stores and gas stations. Overall, Capone (1976) asserts that robbery trip distance is a function of the distribution of opportunities and their different levels of attractiveness to offenders.

Pearlstein & Wachs (1982) studied the criminal impact of extending bus routes in Los Angeles, California. The study selected the Southern California Rapid Transit District (SCRTD) of Los Angeles to employ both interviews and official crime data to determine whether crime in surrounding communities of the bus route increased crime. The SCRTD borders 5 communities that host over 8 million people. The system boasts over 3000 buses with approximately 200 routes (Pearlstein & Wachs, 1982). To determine whether the number of criminal incidents increased crime within the surrounding neighbourhoods of the rail system, a statistical analysis was applied. The study was conducted over a 10 year period and employed several personal interviews with transit security, law enforcement and planning officials to gain further insight into the phenomenon of transit crime.

Results from the study demonstrate that crime on transit had increased, but only in proportion to the level of transit ridership, a number that is concentrated in both space and time (Pearlstein & Wachs, 1982). Communities that witnessed an increase in crime

already experienced high crime rates. Furthermore, crime was disproportionately higher during the evening hours of the day. Bus drivers experienced much higher rates of exposure to the dangers of criminal incidents than transit passengers (Pearlstein & Wachs, 1982). The authors suggested that transportation planning must consider the environment in which transit extension takes place in order to best implement measures to prevent further crime from occurring. The findings concluded by Pearlstein & Wachs (1982) are very insightful for the Canada Line analysis, as levels of criminal offending should be compared to levels of ridership to ensure that crime is the sole factor for a potential marked increase in crime in the surrounding neighbourhoods.

Poister (1996) examined the impact of extending public transportation into suburban neighbourhoods. The study selected 2 rapid rail stations within the Metropolitan Atlanta Transit Authority (MARTA) in DeKalb County, Georgia, US in 1993. Kensington station was selected due to its high rate of activity within the commercial area while Indian Creek station was selected as it represented more residential homes with less activity. Poister (1996) hypothesized that levels and trends of crime during the first 15 months of MARTA rail service would be significantly different from pre-intervention patterns of the stations. Therefore, the level of post-station reported criminal incidents would be greater than pre-station levels, indicating that the expansion of transit stations would facilitate higher levels of crime.

Twelve types⁴ of crime from reported crime incidents were studied over a span of three and a half years prior to the commencement of the new rail system. Crime statistics were then studied for an additional 18 months after the rail system was implemented, providing a context of the type of crime than existed before and after the new system was introduced. Results collected from the study suggest that the implementation of the new transit system could provide new direct access for offenders to seek criminal opportunities within suburban neighbourhoods, as offenders would be able to increase their mental maps of potential areas to offend (Poister, 1996). One type of crime that demonstrated an increase during the intervention period was larceny within the Kensington Station area and burglary in the Indian Creek Station area. Poister (1996) noted during his analysis that burglaries within the Indian Creek Station

⁴ Crimes included for analyses were larceny, assault, burglary, auto theft, criminal trespass, robbery, vagrancy, criminal damage, drugs, disturbing the peace, and homicide.

community should not be directly related to the transit station. Rather, burglaries within the surrounding neighbourhoods of Indian Creek began increasing several months prior to the opening of the station. Poister (1996) suggests that despite some small increases in reported crime surrounding the two stations, the trend of crime tends to return to pre-transit station levels; MARTA should not be held responsible for the small increases witnessed in both Kensington and Indian Creek.

Liggett, Loukaitou-Sideris & Iseki (2003) sought to examine how transit lines can potentially increase the level of crime within communities adjacent to major public transportation systems. The Los Angeles Green Line was selected as the focal point of the study to determine whether the Green Line could export crime from high crime inner city areas to low crime suburban neighbourhoods (Liggett et al., 2003). The transit line is ideal to measure effects of transit on crime as it travels through both suburban and urban neighbourhoods. Suburban neighbourhoods are located within the western end of the line and represent affluent communities. Urban neighbourhoods are located within the middle of line and represent the inner city with a low socio-economic status. Lastly, stations located to the east represent the middle class. Similarly, each area can be easily characterized by ethnicity. Western stations represent primarily Caucasians, inner city stations represent Latinos and African Americans and eastern stations are a mixture of ethnicities. Previous crime statistics reveal that inner city stations have a concentrated amount of crime whereas western and eastern stations host relatively low crime rates. Liggett et al. (2003) contend that the Green Line represents a good case study to test the validity of transit as an exporter of crime.

To evaluate the perception of transit as an exporter of crime, crime data was collected for 6 cities surrounding the Green Line, representing 12 out of 14 stations. Data were collected by type and location during the years of 1990 through 1999 from the cities of Downey, Los Angeles (LAPD service areas in the vicinity of the station), Hawthorne, El Segundo, Manhattan Beach and Redondo Beach (Liggett et al., 2003). Data were geocoded and aggregated to the station neighbourhood level in order to produce a quarterly time-series database for the 10 year period. To help further identify other trends, seasonal variation was also studied. Liggett et al. (2003) attempted to control rival causes by comparing the station neighbourhood trends to the county crime trends during the same period. In doing so, the authors could identify spatial shifts of

crime surrounding the Green Line through geographic information system (GIS) (Liggett et al., 2003).

Results indicate that the Green Line has not exported crime from inner city neighbourhoods to suburban neighbourhoods. Most station neighbourhoods either did not witness any changes or noted a reduction in crime after the implementation of the Green Line. The authors identified a small crime increase within the inner city, where 'limited spill over effects of crime from more high crime to less crime-ridden areas were observed' (Liggett et al., 2003, p.110). Therefore, a relationship between hot spots of crime and the proximity of a transit station did not exist. Rather, the presence of certain land uses was more likely to facilitate crime than a transit system.

3.5 Conclusion

Mass public transportation systems are essential for the development and vitality of a metropolitan city (Clarke, 1996). It is necessary to study and consider the factors which influence the impact of a transit system on crime given the concern residents have around transit development. Studies that have addressed some issues of criminality and mass public transit systems have studied the impact of transit in isolation from other criminogenic factors. Studies such as Capone (1976), Poister (1996) & Liggett et al. (2003) demonstrate the small, but gradual shift into the study of criminal mobility and crime showing the possibility that crime can be facilitated through the expansion of public transit. It is paramount for researchers to understand the decision processes of offenders who either use transit systems to pursue criminal opportunities or use the system to travel to new areas to offend in. Thus, the examination of the Canada Line in BC, Canada, provides a case study to study the impact of a new transit line on the level of criminal offending in the city of Richmond. By utilizing the information garnered from past studies on transit and crime, the current analysis can provide further insight into this phenomenon. The following section provides a contextual background of the Canada Line, including the geography it resides within and the controversy that has fostered the belief that transit increases crime.

4: THE CANADA LINE

4.1 Introduction

The Canada Line is the most recent addition to Metro Vancouver's rapid transportation system, the SkyTrain. The line accommodates passengers travelling from the cities of Vancouver and Richmond to different regions of the Lower Mainland. The Canada Line is an important feature for people who reside and work near the Fraser River as it helps expands options for commuters to travel to different parts of the city with less effort and faster speeds.

Initially, the Canada Line was created to help alleviate traffic congestion between Vancouver and Richmond, primarily from the Oak and Knight Street Bridges (Chiu & Rault, 2003). However, the focus shifted to mainstreaming new public transport routes between the two cities to accommodate passengers for the Vancouver 2010 Winter Olympics⁵ after Vancouver was announced as the host city in the summer of 2003. Construction commenced in 2005 to the ire of local residents and business owners that lived and worked close to the new transport route. Resistance stemmed from retailers and the public over fears of increased crime as well as possible damages sustained to the local residences and businesses from construction of the line (City of Vancouver, 2005). The line was originally scheduled to open on November 30th, 2009, but was completed 15 weeks ahead of schedule, allowing commuters to begin riding the line as of August 17th, 2009 (Chiu & Rault, 2003).

4.2 History

The Canada Line was first considered to be built in the early 1990's, in an attempt to link the corridors of Vancouver and Richmond together (Chiu & Rault, 2003).

⁵ Vancouver was the host city for the XXI Olympic Winter Games in 2010. Sporting events and ceremonies took place February 12th, 2010 – February 28th, 2010. The Paralympics portion of the event took place March 12th, 2010 – March 21st, 2010.

Planners sought to capitalize on the success found when the SkyTrain was first introduced in 1985 for Vancouver Expo '86 (Mackett & Sutcliffe, 2003). However, plans were pushed aside for Vancouver and Richmond as the need to further develop public transport from East to West emerged. A secondary line was introduced in 2002 to mark the turn of the new century with the creation of the Millennium Line, extending from East Vancouver at VCC-Clarke along the Lougheed Highway reaching to Columbia Station in New Westminster. Plans for a transport line between Vancouver and Richmond were once again considered after both cities sought a dramatic increase in population growth. Richmond grew from a population of 126,624 in 1991 to 174,461 by 2006 (BC Stats, n.d.). Vancouver experienced similar growth from a population of 471,844 in 1991 to 578,041 in 2006 (BC Stats, n.d.). Such increases in the number of dwelling residents demonstrate a need to consider and develop alternative commute options in order for both cities to effectively maintain its growth.

Pressures began to mount for public transport to expand when Vancouver was announced as the location of the XXI Olympic Winter Games for 2010 (Chiu & Rault, 2003). With additional funding and support from multiple business partners alongside the provincial government of British Columbia, plans were fast tracked in order to service the large volume of fans and athletes planning to visit Vancouver during the Olympic Games. Furthermore, the announcement of Richmond as a site for many major game and ceremony venues further initiated the development and construction of the Canada Line for Vancouver and Richmond. It was also during this period that the name “Canada Line” was formally adopted for the new SkyTrain line rather than the previous name of “RAV Line” (Chiu & Rault, 2003).

4.3 Facts

4.3.1 Structure

The Canada Line covers 19.2 kilometres of track spanning into the cities of Vancouver and Richmond (City of Richmond, 2006). The line hosts 16 different stations with the ability of adding 3 additional stations in the future (City of Richmond, 2006). In Vancouver, the stations included are Waterfront, Vancouver City Centre, Yaletown-Roundhouse, Olympic Village, Broadway-City Hall, King Edward, Oakridge-41st Avenue, Langara-49th Avenue and Marine Drive. Stations located in Richmond include

Bridgeport, Aberdeen, Lansdowne, Richmond-Brighouse, Templeton, Sea Island Centre and YVR-Airport. For the average commuter, travel times between downtown Vancouver to YVR Airport or Richmond-Brighouse station is approximately 25 minutes in duration (City of Richmond, 2006).

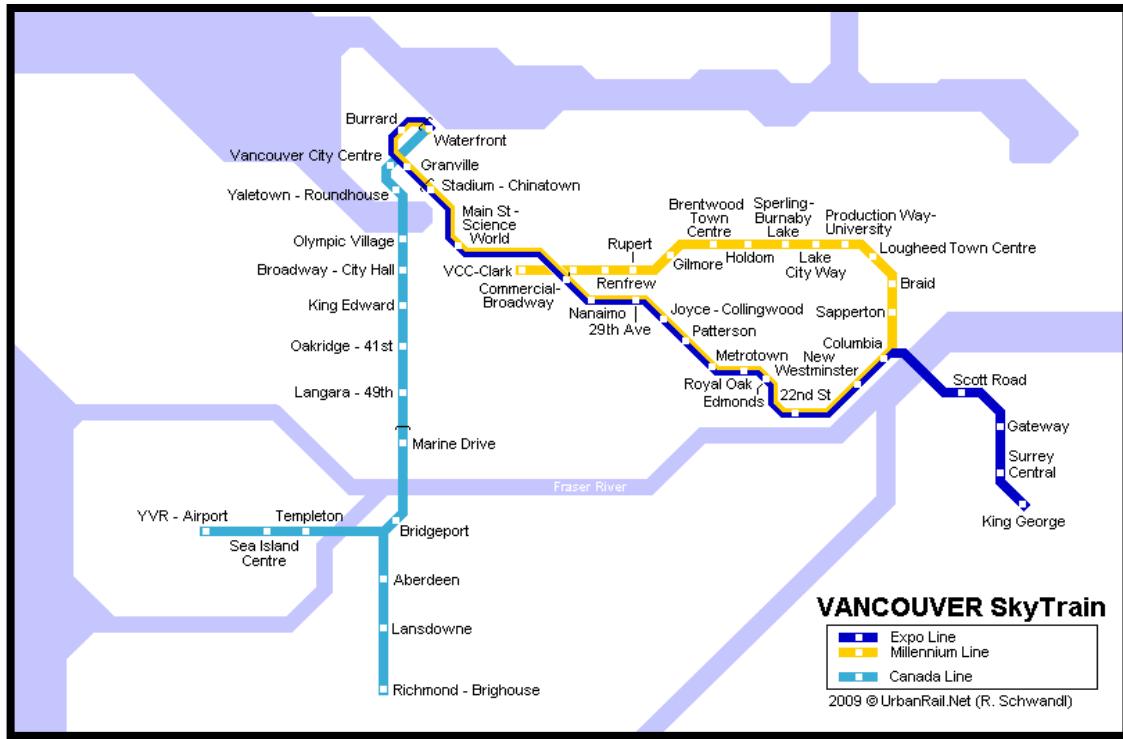


Figure 1: *UrbanRail.net (R.Schwandl)*, 2011

4.3.2 Transfer Points

There are two official transfer points located on the Canada Line. The first transfer point is located at Bridgeport Station in Richmond. Bridgeport Station serves as the junction point between the two different arms of the Canada Line, where commuters can travel to or from Vancouver's International Airport (YVR) located on Sea Island or along No.3 Road in Richmond at the terminal Richmond-Brighouse. Commuters boarding the SkyTrain at Brighouse-Richmond can also commute back to Vancouver, reaching the terminal of Waterfront.

Waterfront is the second transfer point on the Canada Line. This station connects commuters travelling to or from the Canada Line to the Expo Line and subsequently, the Millennium Line. The station also connects the Canada Line to the Seabus that travels to Lonsdale Quay in North Vancouver as well as the Westcoast Express Train that services commuters from Vancouver to Mission.

Although not officially indicated as a transfer point, Vancouver City Centre is a third transfer point for commuters using the Canada Line. Vancouver City Centre allows passengers to travel to opposite sides of Pacific Centre in order to board other SkyTrain Lines, primarily the Expo. Unlike the official transfer points, commuters using the Vancouver City Centre stop to connect to other lines must walk further distances in order to reach the different stations. Due to the inconvenience for some, passengers tend to remain on the Canada Line and travel to the Waterfront Station in order to make switches to different lines.

Unlike its counterparts of the Expo and Millennium Lines, the Canada Line does not run parallel to a pre-existing railroad track. The Expo line follows an old interurban tram line route that was established in 1890 (Rapid Transit Office, 2008). The Millennium Line runs similar to the Expo Line along the Lougheed Highway, travelling from East to West. Both the Expo and Millennium lines have stations that are mostly elevated, further adding to the brand of “SkyTrain”. However, the Canada Line is much different from its counterparts. The Canada Line utilizes underground tunnels that cross the Fraser River and run vertical from Waterfront to YVR and Richmond-Brighouse (City of Richmond, 2006). This new line now serves communities that were never previously exposed to mass public transportation and gives more alternative routes to reach important destinations for passengers.

4.3.3 Ridership

The number of passengers using the Canada Line has dramatically grown from its inception in August of 2009. According to TransLink (2011a) the total level of ridership in 2009 for the Canada Line was 11,391,371. This number was further expanded in the following year with the Vancouver Winter Olympics with an impressive, 38,447,725 trips. Ridership statistics reported thus far for the year of 2011 indicated that between January to June of 2011, 19,185,093 trips were made on the Canada Line

while the Expo and Millennium lines accounted for 39,832,800 trips. The statistics demonstrate that despite the Canada Line being in use for only 2 years, it has proven to account for multiple journey trips for people in all areas of the Lower Mainland. Furthermore, with such large numbers, the potential for the transit line and its stations to foster criminal opportunities has also grown.

Line/Year	2009	2010 (w/o Olympics)	2010 (w/ Olympics)	2011 (Jan-June)
Expo & Millennium	73,067,373	69,391,495	78,965,214	39,832,800
Canada	11,391,371*	33,183,216	38,447,725	19,185,093

Table 1: Statistics derived from TransLink (2011a) & (2011b)

**from August to December 2009 exclusively*

4.3.4 Fare System

The fare system in effect on the Canada Line is the through the honour system by purchasing or validating tickets at a ticket vending machine (TVM). This is the same method employed on different lines of the SkyTrain. Commuters purchase fare based on the number of zones they plan to travel through.⁶ The introduction of the Canada Line witnessed the beginning of additional add-on fares for commuters travelling to and from Sea Island in Richmond. Passengers destined to Bridgeport Station and beyond must pay an additional \$5 dollar charge for rides on the Canada Line. The surcharge was implemented as a provision set out in TransLink's funding plan in 2004 (TransLink FAQ, n.d.). The charge is intended to help make up additional funding 'in order to make the Canada Line viable' (TransLink FAQ, n.d.). Therefore, passengers travelling from Vancouver International Airport pay additional charges.

⁶ Zone 1 encompasses all of the Greater Vancouver area; Zone 2 covers the cities of North & West Vancouver, Burnaby, New Westminster and Richmond; Zone 3 encompasses Coquitlam, Port Coquitlam, Port Moody, Surrey and Langley.

4.4 Reception

Reception to the construction of the Canada Line was extremely negative. Consultations with the public in 2004 reflected many concerns for the mass transportation route (City of Vancouver, 2005). Primarily, concerns were drawn over the overall integration of transit and the surrounding community, safety concerns, increased noise and disruption and potential increased levels of crime and drug activity (City of Vancouver, 2005). The main themes raised by the public mirror the past concerns about mass transportation and the potential increase in crime. Many believe that the introduction of the Canada Line would introduce a wave of new crime, as offenders have the ability to move with more ease around the city in search of more suitable targets to victimize.

An additional fear was a potential increase in crime during construction of the Canada Line. Many merchants, particularly those along Cambie Street, asserted that their stores suffered from an increase in theft amidst construction (Boei, 2006). The store owners claimed that offenders were hiding behind scaffolding in order to steal from the stores. The lack of visibility would cause an increase in drug users and dealers to be drawn into the Cambie area to consume and sell drugs. Furthermore, residents and retailers alike feared that an increase in mugging could also occur from a lack of visibility (Boei, 2006).

The city of Richmond also feared an increase in crime. Law enforcement according to Richmond City Council may have to increase their workload equivalent to 14 police officers within the first year alone of the operation of the Canada Line in order to combat potential crime and the fear of it from the transit line (Bennett, 2008). According to Richmond RCMP, ‘the entire No.3 Road commercial corridor, the precinct in which the River Rock Casino and the Bridgeport park-and-ride facility are located, and the terminus station at the YVR passenger terminal all become target-rich environments for criminal activity” (Bennett, 2008, p.B2).

4.5 Conclusion

The development of the Canada Line has both positive and negative attributes. By identifying the different characteristics of the Canada Line, a greater understanding of the different dynamics between public perception and factual truth can be examined. The following section empirically tests whether the introduction of the Canada Line has negatively impacted the surrounding communities in Richmond in terms of an increased amount of crime.

5: METHODOLOGY

5.1 Introduction

The Canada Line is one of three SkyTrain routes currently in operation within the Lower Mainland of British Columbia. As the most recent addition to the SkyTrain, the Canada Line provides new opportunities to travel to work, school and leisure activities. However, as opportunities to travel have increased with the Canada Line, so too has the number of opportunities to commit crime. Potential offenders can travel effortlessly between different cities in pursuit of new targets to victimize. The following section provide an overview of the current research undertaken to determine whether the Canada Line has provided offenders new pathways to travel to commit crime. The research aims to provide a statistical analysis of the Canada Line on the local crime rate within Richmond, BC. Such research will potentially demonstrate a relationship between the expansion of mass transit and its effect to distribute crime spatially within metropolis cities that host rapid transit routes.

5.2 Sample

The aim of the current research was to determine whether the expansion of the SkyTrain, specifically the Canada Line, has changed the crime rate in communities surrounding the stations of the transit route. For the purposes of the current research, seven stations located in Richmond, BC were examined as part of the Canada Line⁷. Stations included for analyses were Aberdeen, Bridgeport, Lansdowne, Richmond-Brighouse, Sea Island, Templeton and YVR-Airport. Crime incident data from the Police Records Information Management Environment for British Columbia (PRIME-BC) was provided by the Richmond RCMP detachment and covered the time period January 2006 through August 2011.

⁷ The City of Vancouver was excluded from the current research due to data constraints.

Crime statistics were derived from ‘actual offences’, indicating crimes that upon preliminary police investigation were deemed to have occurred or been attempted (RCMP, 2011). Crime data was obtained from both the Richmond RCMP and the South Coast British Columbia Transportation Authority Police Service (Transit Police). It is important to note that criminal incidents recorded for the sample occurred within a 250 meter buffer surrounding each Canada Line station in Richmond (See Appendix A). RCMP (2011) note that the 250 meter buffer surrounding the YVR-Airport Station only includes activity at the International Terminal, excluding any potential activity at the Domestic Terminal. This is due to PRIME addressing conventions (RCMP, 2011). Thus, by providing a 250 meter buffer, criminal incidents included within the sample either directly occurred within the station or very close to the transit station.

Incidents of crime were classified into three general categories of crime: violent crime; property crime; and other criminal code offences. Violent crime includes crimes such as the use or threatened use of violence against a person such as homicide, attempted murder, assault, sexual assault and robbery (Statistics Canada, 2009). Property crimes are defined as the unlawful act(s) to gain property. Such offences include theft, break and enter and fraud (Statistics Canada, 2009). Lastly, other criminal code offences can include offences that have not been classified as violent or property (excluding traffic offences). Such crimes include mischief, disturbing the peace, arson and prostitution (Statistics Canada, 2009). Overall, there were 851 incidents of reported violent crime, 6538 incidents of reported property crime, and 1997 incidents of reported other criminal code offences for all stations between January 2006 and August 2011.

Violent	Property	Other	Total
851	6538	1997	9386

Table 2: Reported crime between January 2006 and August 2011 (Richmond, RCMP)

5.3 Hypotheses

The goal of the current study was to determine whether the Canada Line had the ability to export crime to different parts of the city, based on its expansion of the route

into South Vancouver and Central Richmond. Previous studies have indicated that mass transit systems such as subways, buses and other forms of rapid transit have the ability to increase crime based on the mobility of potential offenders (Capone, 1976; Liggett et al., 2003; Pearlstein & Wachs, 1982; Poister, 1996). The primary hypothesis for the current research proposes that each Canada Line station within Richmond will experience an initial increase in crime (across all categories) after the implementation of the Canada Line in August of 2009. The study's secondary hypothesis states that the level of crime (all categories) reported surrounding the Canada Line stations will begin to decrease to pre-Canada Line crime rates by the year of 2011. Therefore, crime should initially increase with the implementation of the route, but should return to crime rates reported before the application of the new line.

5.4 Variables

Each Canada Line station in Richmond was examined to determine the impact that the SkyTrain had on the level of reported crime. In order to determine the impact of the Canada Line on crime levels in Richmond, violent, property and other criminal code offences were used as the dependent variables within the study to empirically test for changes to the crime count during the selected time period. Crime was estimated in the following equation:

$$Crime = \alpha + \beta_1 Trend + \beta_2 Month + \beta_3 Month^2 + \beta_4 CL + \beta_5 CL Trend \quad (1)$$

The Trend variable was included to account for the crime trend within Richmond. The Trend variable takes on sequential values of each monthly observation (1, 2, 3...). Month and Month Squared serve as seasonality variables. The variable Month takes a value of "1" for January, "2" for February and so forth. Month-squared is the squared value of Month. Such independent variables account for crime peaking in the summer months and decreasing during the winter months (Harries, Stadler & Zdorkowski, 1984). CL (Canada Line) is a dichotomous dummy variable used for taking a value of unity (one) in all months from August 2009 to August 2011 and zero otherwise. This variable helps eliminate any possible influences these particular months may have in relation to crime within a given city (Andresen & Tong, 2012). CL (Canada Line) Trend variable is an additional dummy variable used. The CL Trend variable is very similar to the Trend

variable except the CL Trend variable begins its sequential values (1, 2, 3...) at the time of the intervention and is otherwise, zero beforehand. This variable accounts for the crime trend after the intervention of the Canada Line was made operational. Such indicators help provide analysts to determine what the current crime trend is within the region (Andresen & Tong, 2012).

5.5 Time Series Analysis

Time series analysis was applied to assess the criminal impact of the Canada Line within the City of Richmond. Time series analysis is the collection of observations made sequentially through time (Chatfield, 2003). Time series analysis is an applicable statistical technique for the current research as the sample contains crime data collected at various time points. The analysis can provide considerable insight into the relationship between crime and mass transportation as it can help identify significant changes to the crime rate over a period of time.

To apply time series analyses, the use of structural break tests were required to assess for changes to the crime rate along the Canada Line. Structural break tests are often employed in time series analyses to test for changes over time. Such tests have been popularized in economics and statistics as they help identify multiple changes within the data while accounting for other rival causes (Andresen, Reid & Jenion, 2010; Andresen & Tong, 2012; Reid & Andresen, 2012). Within the current context of the Canada Line, time series analyses can be employed to test for the presence of such structural breaks to detect changes to the crime rate while taking into account rival plausible causes such as general crime trends and seasonality. The utilization of structural break tests can test whether the independent variables of Trend, Month, Month², CL and CL Trend has had any impact on any of the Canada Line stations in Richmond.

In order to test for changes within the crime rates surrounding the Canada Line, several structural break tests were employed through the utilization of linear regression models. Such models consider the association between several trends and the number of violent, property and other criminal code offences in a variety of spatial units (Andresen & Tong, 2012). Through the consideration of the varying trends, the current research has the potential to identify the immediate impact, on-going impact, and the

general crime trend of the Canada Line throughout the selected time period. Therefore, a combination of both structural tests and linear regression models are needed to assess for changes to the crime rate surrounding the Canada Line.

Within time series analyses, it is very important to test for the presence of autocorrelation. Autocorrelation describes a relationship between values separated from each other by a given time lag in the residuals (prediction errors) from a regression analysis (Chatfield, 2001). Autocorrelation is considered a negative attribute within time series analyses as it violates the ordinary least squares (OLS) assumption that the error terms are uncorrelated (Chatfield, 2001). In order to assess whether autocorrelation is present within the current crime data, examination of the Durbin Watson test statistic was performed. The Durbin Watson statistic ranges in value from 0 to 4; a value towards 0 indicates positive autocorrelation; a value near 2 indicates non-autocorrelation; and a value of 4 indicates negative autocorrelation (Chatfield, 2001). No evidence of autocorrelation was found in the current analyses as all significant values resulted in a value proximate to 2.

5.6 Conclusion

Through the use of structural break tests, linear regression models and autocorrelation, analysis of the Canada Line was performed to assess the potential impact of crime on transit of the new route. The following chapter explores the results of these tests. Exploration of each station is performed to account for both general and specific trends witnessed from the Canada Line. A discussion of the results follows to describe the changes observed within the selected time period.

6: RESULTS

6.1 Introduction

Public transportation is a diverse environment with the ability to foster or prevent fear, danger and crime. However, with limited studies examining the overall impact of new transportation routes, one cannot validate whether such fears of crime are reasonable. The study of public transportation and crime requires the use of several quantitative methods to demonstrate statistically the impact of transportation on the level of crime within a given city. The current study has applied the use of several linear regression models to determine whether or not the Canada Line has increased, decreased or had no effect on the crime rate surrounding each Richmond SkyTrain station. The following sections provide the results of the structural break tests applied to the crime data to demonstrate the effect of the Canada Line on different categories of crime.

6.2 Overall Trends in Crime Rates

The results of the structural break tests using PRIME-BC data are reported in Tables 1 through 8, organized by station. Violent crime was positively statistically significant, across all stations, resulting in an increase of 4.631 reported crimes to the Richmond RCMP since the implementation of the Canada Line. However, despite the initial increase, the general crime trend from the results has indicated that violent crime has begun to decrease. This current trend should be closely followed within the subsequent year as such findings may demonstrate that the crime rate is slowly returning to pre-Canada Line crime rates and trends.

Overall, there is some evidence that the Canada Line SkyTrain route has decreased other forms of crime. Categories of crime that were negatively statistically significant, across all stations were property crime and other criminal code offences.

With a coefficient of -16.208 each, there were 16 fewer property and 16 fewer other criminal code offences reported to the Richmond RCMP during the months following the implementation of the Canada Line. Such results indicate an average decrease of 0.675 of property and other criminal code offences each per month since August 2009.

Table 3: Regression Results, All Stations

	Violent	Property	Other
Trend	-.015	.309	.309
Month	.078	-4.096	-4.096
Month2	-.013	.263	.263
CL Dummy	4.631*	-16.208*	-16.208*
CL Trend	-.070	.531	.531
R²	.173	.150	.150

*Note: * Significance under .005, ** Significance under .001*

6.3 Specific Changes in Trends in Crime Rates

6.3.1 Violent Crime

Violent crime increased and decreased along the seven individual Richmond Canada Line stations. Overall, for all stations, a small increase occurred in the number of violent offences. This increase was shown through the CL Dummy variable that demonstrated that an increase of 4 crimes occurred from 2009. Despite an increase, the number of violent offences is limited.

Sea Island was one of few stations that experienced a small decrease in the number of violent offences reported to the Richmond RCMP. Sea Island reported -0.0112 fewer violent crimes since August 2009. Although this finding indicates an extremely small change to the crime rate, it nevertheless indicates a possible downward shift to the level of violent offences taking place surrounding the station. Due to its geographical location, Sea Island Station is situated very close to Vancouver's International Airport. Such decreases to the violent crime rate could be attributed to the presence of more guardians surrounding the station. Many hotels, small cafes and/or restaurants are located close to the station and may serve as a deterrent to potential offenders seeking to commit violent crimes nearby.

YVR-Airport demonstrated that a small increase had occurred in the number of violent offences that took place at the airport, with 1.485 more violent crimes occurring following the implementation of the Canada Line. However, the overall trend of violent crime since the Canada Line has become operational has shown that violent crime is beginning a downward trend. This downward trend demonstrates a decrease of -.104 offences. The small increase in reported violent crime could be attributed to the volume of targets within the airport as more people have opted to commute via public transit rather than utilize their own vehicles and taxi cabs to reach the airport. Such findings demonstrate the main hypotheses of the current study, suggesting the small increase is temporary as rates return to pre-Canada Line crime rate averages.

Table 4: Regression Results, Aberdeen Station

	Violent	Property	Other
Trend	-.012	-.031	-.023
Month	.175	.324	-.228
Month2	-.013	-.019	.018
CL Dummy	.233	-1.287	.112
CL Trend	.026	.274*	.118*
R²	.027	.136	.139

Note: * Significance under .005, ** Significance under .001

6.3.2 Property Crime

Property crime had larger increases and decreases throughout the various SkyTrain stations in Richmond. Overall, property crime experienced a large decrease in the number of offences related to personal and commercial property since the implementation of the Canada Line. A total of 16 fewer offences took place since August 2009. This is a rather surprising result as property crimes occur with more frequency than violent crime (Smith & Clarke, 2000). Thus, property crime was expected to increase with the introduction of the new line but has not.

Aberdeen SkyTrain station experienced a small increase within the property crime rate trend. A subtle increase of .274 more property crimes occurred during the

time following the introduction of the Canada Line. The slight increase could be attributed to the number of nearby businesses, stores and local hotel/motels situated close to the SkyTrain station. Motivated offenders may have used the Canada Line as a new pathway to enter and escape the local surroundings of Aberdeen Station to commit property offences. Further analyses would be necessary to produce more definitive causes to the increase in crime.

Table 5: Regression Results, Bridgeport

	Violent	Property	Other
Trend	-.022	-.034	-.004
Month	.172	-.076	-.644*
Month2	-.014	-.013	.054*
CL Dummy	.330	5.757**	1.664
CL Trend	.051	.174	.005
R²	.080	.520	.197

Note: * Significance under .005, ** Significance under .001

Bridgeport SkyTrain station also experienced an increase in the number of property offences reported to the Richmond RCMP; however, the increase is quite large compared to the increases experienced by Aberdeen SkyTrain station. The increase in property crime at Bridgeport station resulted in 5.757 more crimes occurring since the implementation of the Canada Line. However, the increase is somewhat expected due to the geographical location of the station. Bridgeport SkyTrain station is the first Canada Line station when entering into the City of Richmond. With Bridgeport station located along a physical edge between land and water (the Fraser River) as well as a perceptual edge between the cities of Vancouver and Richmond, crime, according to the Geometric Theory of Crime (Brantingham & Brantingham, 1981), should be prevalent at surrounding edges than elsewhere within an individual's awareness space. Furthermore, the station is located very closely to the River Rock Casino. With hundreds of individuals travelling to the casino, the amount of available targets has also increased to victimize against. Targets include motor vehicles within the car parks surrounding the casino and the SkyTrain station, and large quantities of money and goods found on persons entering and leaving the casino. Therefore, with an increase of vulnerable targets, it is expected that the route could facilitate more crime.

Table 6: Regression Results, Lansdowne

	Violent	Property	Other
Trend	-.007	.276**	.016
Month	-.009	-2.288**	-.087
Month2	.004	.145*	.011
CL Dummy	1.088	-6.758*	.348
CL Trend	.022	-.334	.014
R²	.137	.298	.134

Note: * Significance under .005, ** Significance under .001

Lansdowne SkyTrain station witnessed the greatest amount of changes to the crime rate than any other Canada Line station. The property crime trend surrounding the Lansdowne station demonstrated a small increase in the number of property related offences reported, of .276 more crimes. An increase was also witnessed in the variable Month² that showed an increase of .145 offences. Decreases were witnessed in the variable Month of -2.288. Such findings could be attributed to the seasonal highs and lows of crime committed with fluctuations in the weather. Harries, Stadler & Zdorkowski (1984) contend that property crime increases during colder seasons such as autumn and winter, where as more people commit violent crimes with increases in the temperature in warmer seasons such as the spring and summer. Such findings are based from the assumption that with warmer temperatures, more people are outdoors and are more likely to victimize one another. However, with cold temperatures, people are more likely to victimize different forms of property. Therefore, seasonality can be attributed to the slight increase and decrease in crime experienced by the Lansdowne SkyTrain Station.

A decrease was also apparent from the CL Dummy variable, with 6.758 fewer property offences since the Canada Line opened. This is a rather intriguing result. Within Appendix B, under Lansdowne SkyTrain station, one can see that several shopping centres are within the close vicinity of the station. Businesses include Lansdowne Mall, Ackroyd Mall, and other various small commercial stores. Furthermore, the station is situated along the main road in Richmond, No.3 road. With an abundance of potential targets, it is rather surprising that property crime would decrease after the implementation of the Canada Line. However, such results could be accounted for by the number of potential capable guardians surrounding Lansdowne

Station (Cohen & Felson, 1979). Although the number of opportunities has increased with the implementation of the new line, the number of guardians has also increased; therefore indicating a null effect on the local crime rate.

Table 7: Regression Results, Richmond-Brighouse

	Violent	Property	Other
Trend	.035	.087	.042
Month	-.568	-1.332	.345
Month2	.032	.087	-.026
CL Dummy	1.163	-7.577	1.457
CL Trend	-.064	.092	.054
R²	.143	.058	.299

Note: * Significance under .005, ** Significance under .001

Lastly, Vancouver International Airport, YVR, also experienced a decrease in the number of property related offences since the implementation of the Canada Line. The regression model reported a decrease of -6.105 of the coefficient, indicating 6 fewer offences took place at the airport since August 2009. It is interesting to see that a station with a high volume of targets, both people and property witnessed a reduction in property crime. However, in relation to Cohen & Felson's (1979) theory of routine activities, crime may be suppressed at such activity nodes and pathways due the number of capable guardians present to detect and report crime. With a surplus of transit authority for both the airport and the SkyTrain, many potential offenders may view the station as too guarded and therefore pass on criminal opportunities to avoid being detected and apprehended. Such forms of thought reflect the theoretical arguments suggested by Cornish & Clarke (1986).

Table 8: Regression Results, Sea Island

	Violent	Property	Other
Trend	-.012*	-.011	.005
Month	.079	-.120	.007
Month2	-.004	.008	-.001
CL Dummy	.331	-.125	.050
CL Trend	-.001	.041	-.008
R²	.146	.088	.058

Note: * Significance under .005, ** Significance under .001

6.3.3 Other Crime

Other criminal code offences demonstrated a large decrease in the level of reported criminal code offences, similar to the findings found for property related crimes. Other criminal code offences witnessed a decrease of 16 offences since August of 2009 when the Canada Line was first operational within the Lower Mainland. This result contrasts against the primary hypothesis of the current research. Rates were expected to increase following the introduction of the Canada Line rather than significantly decrease. The result is intriguing to further explore as like many of the stations within Richmond, there are many businesses, stores and residences located nearby the stations that could have influenced the crime rate through the availability of targets.

Table 9: Regression Results, Templeton

	Violent	Property	Other
Trend	NA	.003	.003
Month	NA	.021	.005
Month2	NA	-.002	-.001
CL Dummy	NA	-.113	-.102
CL Trend	NA	.002	.002
R²	NA	.076	.066

Note: * Significance under .005, ** Significance under .001

Aberdeen SkyTrain station witnessed a small increase in the trend of other criminal code offences. A coefficient produced .118 more other criminal code offences from the CL dummy variable. Taking into consideration the geographic location of the

station, such types of crime can increase. This is due to the many businesses and retail stores close by to the station as well as the airport. Such findings support the primary hypothesis of the current research.

Bridgeport SkyTrain station witnessed an increase in the variable Month², with .054. A decrease in the variable Month at Bridgeport produced -.644 fewer offences. Such results are reflective of the aforementioned discussion of seasonality and crime (Harries, Stadler & Zdorkowski, 1984). Findings collected from the stations within Richmond demonstrate the importance of considering seasonality in the decreases and increases in crime. In particular, the large decrease witnessed within the category of other criminal code offences demonstrates how different types of crime can be impacted based on the weather. Many types of other criminal code offences include activities such as mischief, disturbing the peace and prostitution. Such activities will substantially decrease due to colder temperatures. Therefore, such forms of crime may decrease due to a lack of activity outdoors during colder months in the City of Richmond.

Table 10: Regression Results, YVR

	Violent	Property	Other
Trend	.003	.018	-.014
Month	.229	-.624	-.615
Month2	-.018	.057	.062
CL Dummy	1.485*	-6.105*	2.019
CL Trend	-.104*	.282	.097
R²	.121	.078	.119

Note: * Significance under .005, ** Significance under .001

6.4 Conclusion

The results obtained from the current analyses have demonstrated that the Canada Line has the ability to serve as a crime attractor in some regions but mostly a deterrent for motivated offenders. Most stations provided validity for the primary and secondary hypotheses. However, some unexpected results have demonstrated the importance of considering land use and strategic planning on the local crime rate. The

following section provides a more comprehensive examination of other rival factors to help explain the drop in the level of reported property and other criminal code offences since the Canada Line became functional in late 2009. Consideration of police strategy, architecture, national crime rates and the Vancouver 2010 Winter Olympic Games will be explored. Such findings provide the basis for cooperative partnerships between planners, police and the community for the development of policy in the expansion of different forms of public transportation within the urban landscape.

7: DISCUSSION

7.1 Introduction

This research examined 68 months of crime data from Richmond RCMP considering violent, property and other criminal code offences. Through the examination of crime data collected from the Canada Line, several conclusions can be offered to assist with the current study of the relationship between public transportation and crime. The following sections provide several explanations collected from the analyses to provide context and insight into the results of the study. The use of such results will help develop implications for policy, research, and planning for future public transit routes within the Lower Mainland.

7.2 Current Study

A comparison of crime counts along Richmond's Canada Line stations shows that overall, the Canada Line has not exported an increased number of crimes from adjacent cities to the City of Richmond. Violent crime surrounding most of the Canada Line in Richmond did not change from the introduction of the new transit route. The primary and secondary hypotheses were validated at one SkyTrain station, YVR-Airport. Violent crimes initially increased after the Canada Line opened, but are returning to pre-intervention levels for violent offending. The results obtained from an analysis of violent offending surrounding the Canada Line has demonstrated that the introduction of potential new pathways can have a short term impact on the level of offending surrounding a transit station but the effect is mitigated over time. In the context of YVR-Airport, a surge in the volume of people travelling to and from the airport in conjunction with the novelty of the line may increase criminal opportunities. Mobile commuters can become victims of violent offending as motivated offenders have been exposed to a selection of new targets that were not once available to offend against. Special consideration should be given to new transit routes in order to counteract any possible opportunities to commit crime, especially violence. Proactive measures should be

implemented in the form of crime prevention (i.e. CPTED principles, pro-active policing, community engagement) to help ward off the initial effects of a new transit route on the surrounding nearby businesses and residences.

However, unlike violent offending, the number of property and other criminal code offences along Richmond's Canada Line SkyTrain has decreased. The results were unanticipated. Rather than an expected increase, the categories of property and other criminal code offences have witnessed large decreases after the Canada Line was implemented. Such findings are apparent within a number of stations including Lansdowne and YVR-Airport. Therefore, a number of rival causes should be considered to account for changes in crime aside from the Canada Line itself. The following subsections provide context to the decreases shown through property and other criminal code offences since August 2009.

7.3 Rival Causes

Many factors can influence police-reported crime. Juristat (2011) reports a number of factors that can impact the level of crime officially recorded. Factors can range from changes to the demographics of a region, the economy, reporting practices to the police, technological advancements and legislative amendments. Crime, especially offences that take place in public environments such as public transit, can often be difficult to record. Difficulties can result from the inability to locate offenders who flee from the scene, victims reluctant to report their crimes to the police and the inability of the police to apprehend and punish the violating offender (Smith & Clarke, 2000).

The implementation of the Canada Line was completed in August of 2009. However, taking into consideration factors and practices that can influence the level of police reported crime; many rival causes of crime may have contributed to the decline of property and other criminal code offences experienced within the City of Richmond. The following sections outline some potential rival causes to the substantial decreases experienced by property and criminal code offences.

National & Provincial Crime Rate

A major factor that has influenced the results of the current research is the national and provincial crime rates within Canada. In 2010, it was reported that the national crime rate (volume and seriousness) reached its lowest level of reported crime since 1973, with 77,000 fewer crimes (Juristat, 2011). On the decline, property crime experienced the greatest decreases within Canada. Crimes that decreased the most included theft under \$5000, theft of and from motor vehicles and breaking and entering (Juristat, 2011). According to official crime statistics, non-violent crimes decreased by 6%. The findings of such results help establish the seventh consecutive year in the decline of non-violent crime (Juristat, 2011). Other categories of crime such as violent crime also experienced some decreases, especially within crimes such as homicide, attempted murder, robbery and assault. Other criminal code offences remained unchanged (Juristat, 2011).

In 2010, both the volume and the severity of crime reported by the police declined or remained stable across Canada (Juristat, 2011). Among the provinces, Alberta and British Columbia accounted for the largest declines. Specifically, the crime rate in British Columbia decreased by 6% as well as a 7% decrease to the level of seriousness of crime reported to the police (Juristat, 2011). Decreases within the national and provincial crime rates have demonstrated the continual downward shift in crime within the country. Such decreases may have contributed to the decline in property crime other than the Canada Line SkyTrain system. Although the crimes that were recorded for the sample occurred within a 250 meter buffer zone of each Richmond Canada Line station, the effect of the general crime rate may have impacted the surrounding communities regardless of the new transit route. One must take into consideration the effect of the general crime rate, as it has the ability to decrease the level of crime officially reported to the police. However, for the current analyses, the general crime trend was controlled by the trend variable. Thus, the results indicate that the level of offending was declining regardless of the implementation of the Canada Line.

Winter Olympic Games 2010

Another factor to consider in the decrease of crime is the role of the 2010 Winter Olympic Games. The Vancouver 2010 Winter Olympic Games took place between February and March of 2010. The amount of news and media coverage of the Olympic Games combined with the level and volume of visitors attributed to a significant increase in the number of commuters using the Canada Line to participate and attend various winter sport games. TransLink (2011) reported an increase of over 5 million (5,264,509) additional trips during February and March 2010 to accommodate passengers travelling to see the Olympic Games in various locations of the Lower Mainland, especially the City of Richmond.

Utilizing the arguments brought forth by Cohen & Felson (1979), the volume of additional people travelling the Canada Line has increased both the number of criminal opportunities and the number of capable guardians within each SkyTrain station. However, the increase in the number of capable guardians may serve as a deterrent against crime. Although many of the commuters may represent ideal criminal targets (person and property), motivated offenders may resist the opportunity to commit crime due to the large number of crowds at the SkyTrain station, especially during the Olympic Games. More commuters may represent a greater likelihood of an offender being detected, identified and reported to local law enforcement, as each commuter may represent a capable guardian for a target. Furthermore, the Olympic Games also produced an abundance of transit and regular law enforcement officers at each station to ensure the safety of passengers using the Canada Line during the Games. Therefore, negating any increase in the number of suitable targets as the presence of capable guardians increased.

With more natural surveillance present during the Olympic Games at the Canada Line SkyTrain route, many motivated offenders may have been deterred from committing crime as detection and apprehension increased. This potential cause to the decline of crime experienced at the Canada Line reflects upon Rational Choice Theory by Cornish & Clarke (1981). Offenders who seek targets to victimize against within the transit environment must weigh both the benefits and costs of committing crime; determining whether the benefits of the commission of an offence will outweigh the costs of committing the crime. It is probable that the increase in the number of visitors and police

at each Canada Line station helped contribute to the decline in the number of property and other criminal code offences that took place since the implementation of the Canada Line. Further testing should be conducted excluding the months in which the Olympic Games took place to determine whether the results of the current study would change to reflect a different conclusion. Overall, the Olympic Games are a rival cause that should be considered in the decline of crime within property and other criminal code crimes.

Routine Activities

Another plausible explanation to the decline in both property and other criminal code offences is the role of capable guardians at each SkyTrain station. Although mass forms of transit produce a large volume of commuters travelling back and forth between Vancouver and Richmond, inadvertently, the number of people located at each SkyTrain station serves to become natural forms of surveillance. Using the theoretical arguments provided by Cohen and Felson (1979), one could argue that an increase in the number of people within a station can serve to provide capable guardians willing to detect different forms of crime and thus preventing the commission of crime. Motivated offenders may be reluctant to seize criminal opportunities based on the inability to approach a target without being detected. Therefore, any increases in the number of motivated offenders or the number of targets could have no impact on the crime rate as long as there are more capable guardians present. Such implications can serve to explain the various drops in the level of reported crime for various stations with Richmond such as Aberdeen, Lansdowne, Sea Island and YVR-Airport.

Strategic Planning

A critical aspect to consider in the general decline of crime along the Richmond stations of the Canada Line is the role of CPTED (Crime Prevention through Environmental Design). The Canada Line, unlike its counterparts, the Expo and Millennium Line, has consistent design and structure throughout its entire route, including the Vancouver portion of the Canada Line. As previously noted in the literature, CPTED has proven to be extremely effective situational crime prevention technique in the reduction of nuisance and crime (Felson et al, 1996; Gaylord & Galliher, 1991; La Vigne, 1996; Myhre & Rosso, 1996).

As noted by Gaylord & Galliher (1991) the concept of ‘design out’ can alter the physical environment to control for the number of criminal opportunities available for possible offenders to seize. The Canada Line’s stations are designed to eliminate hidden corridors and walls, increase visibility, provide no public places to sit and loiter and provide an enhanced level of CCTV monitoring. With the lack of opportunities to commit crime due to the increased levels of both mechanical and natural surveillance, the Canada Line has helped contribute to deterring crime from occurring within its stations. Effort has been made to reduce opportunities for crime at the design stage.

Another aspect to consider in the decline of crime is the role of policing. As reported by Bennett (2008), the city of Richmond feared that the introduction of the Canada Line would increase crime to adjacent neighbourhoods surrounding the stations. In response to such fears, Richmond RCMP deployed additional police patrols to counteract the potential negative effect of the mass transit route on the city’s crime rate. An increase in police patrols may balance increases in the number of motivated offenders and suitable targets. Therefore, the role and timing of police patrols from both the RCMP and Transit Police is important in strategic planning. Overall, the consistency within the Canada Line’s design and the level of policing surrounding the SkyTrain stations has served as a general deterrent to prevent crime from occurring at the Canada Line stations within Richmond.

7.4 Policy Implications

There are several policy implications that arise from the current research into the relationship between crime, offender mobility and mass transit. Contrary to common fears, the Canada Line has not resulted in a substantial increase in the level of reported crime. Rather, the results of the study have indicated that the new SkyTrain route into Vancouver and Richmond has over time decreased crime from occurring.

As a result, future city planners, architects and police agencies can develop several policies that can help guide future transportation routes. The success of implementing uniformly structured stations through the concept of CPTED can be regarded as a mandatory, rather than optional design plan. Stations with uniformity lack opportunities to attract potential offenders to commit crime and thus, all future SkyTrain routes should model their stations based on CPTED techniques.

Policies could also be developed to have more collaborative efforts be initiated between city municipalities' planning departments and the local transportation police. Such relationships could provide both the knowledge and expertise to create safe environments that allow for commuters to travel with ease around the city as well as prevent opportunities to create danger, fear and crime. These partnerships can deploy more police patrols to help prevent crime from occurring within and surrounding transit stations.

Such policies will prove to be proactive in its stance to prevent crime as the Lower Mainland prepares for major public transit expansion plans in the near future. The introduction of three large expansion routes of the SkyTrain arises from the need to increase functional pathways to cities beyond the downtown core of Vancouver. Proposed lines include the Evergreen line, from Burnaby to Coquitlam; the UBC Line, from East to West Vancouver; and the expansion of the Expo Line, the extension of the SkyTrain from King George Station to South Surrey. With knowledge gained from the Canada Line, cities and police alike can work towards providing a functional operational plan to provide the appropriate infrastructure required to serve the growing population of the Lower Mainland. In doing so, the demand created from population growth can be delivered in a safe setting that does not expose such mobile populations from becoming victims of crime.

7.5 Limitations

There are some limitations associated with the current research. Like many studies of crime, the study only includes reported criminal incidents. The dark figure of crime, where more crime occurs but is not reported, can alter the results obtained from the study. More crime may have taken place within the parameters of the study but was not reported. Consequently, crime, that was reported but may have not have been deemed to occur, may also be excluded. This exclusion reflects the discretion utilized by the police to determine whether a criminal offence took place or not. Therefore, the number of crimes that actually could have occurred may have been excluded from the analyses. Furthermore, the study utilized crime data collected within a 250 meter buffer zone of each Richmond Canada Line Station. Crimes that exceeded the buffer zone

were not included and may have impacted the results of the study, had they been included.

Another limitation is the use of general categories of crime. Without the crime rates of specific crimes, it is very difficult for local law enforcement agencies to implement appropriate remedies to counter-attack crime. One cannot individually specify which crimes were significantly greater to the increases and declines of the crime rate during the specified time period of the study. Tailored crime prevention programs and techniques must know specific types of crime to generate the greatest effectiveness in preventing crime from occurring. Future studies on the relationship between crime and the Canada Line should include specific categories of crime to differentiate between different forms and general crime categories.

7.6 Future Research

The results obtained from the current research into the relationship between mass transportation and crime holds several implications for future research. Future studies should utilize the approach to transit and crime from the Canada Line and implement the appropriate safeguards to deter crime from occurring on the proposed future SkyTrain lines aimed for Coquitlam, Port Moody, Vancouver and Surrey. Analyses should be conducted on each SkyTrain line annually to determine whether changes should be made to the strategy deployed by the police and city planners. Future research should also explore the differences between crime rates of specific forms of crime as well as the inclusion of the Vancouver portion of the Canada Line to study the overall criminal impact from both cities of Vancouver and Richmond.

Various land uses, general crime rates and strategic planning highlight the importance of considering the urban landscape when implementing new pathways for commuters to use while travelling to work, school and leisure activities. Collaborative relationships between various agencies should be negotiated to work together to prevent crime from occurring. Such partnerships serve to strengthen formal responses to crime to keep local communities safe from danger and crime.

8: CONCLUSION

Mass transit exists within a complex environment containing a variety of temporal and spatial patterns. Within a criminological context, the transit environment contains a multitude of targets that are stationary and unguarded; thus providing ample criminal opportunities for motivated offenders to select and victimize against (Smith & Clarke, 2000). Therefore, it is extremely important for city planners, the police and the community to engage in proactive measures to prevent crime from occurring in vulnerable public settings. As demonstrated in previous literature, there is a continual need to study the relationship between offender mobility and mass forms of public transportation. Previous studies that have attempted to explore this relationship have offered important, but limited results (Capone, 1976; Pearlstein & Wachs, 1982; Poister, 1996; Liggett et al., 2003).

The aim of the study was to determine whether the introduction of the SkyTrain's Canada Line into the City of Richmond, BC had changed the local crime rate following the implementation of the new route. Exploration of seven stations across three general categories of crime illustrated a decline of property and other criminal code offences. The primary hypothesis expected to witness an increase in crime following the introduction of the new pathway into Richmond. However, the hypothesis was not substantiated with the general findings that crime declined since August of 2009. The results of the study indicate other plausible causes rather than the creation of the SkyTrain line may have contributed to the decline, primarily the Vancouver Winter Olympic Games, strategic planning and the national crime rate. However, with crimes limited to a 250 meter buffer zone at each station, it can be argued that the SkyTrain has acted as a deterrent effect to Richmond's crime rate.

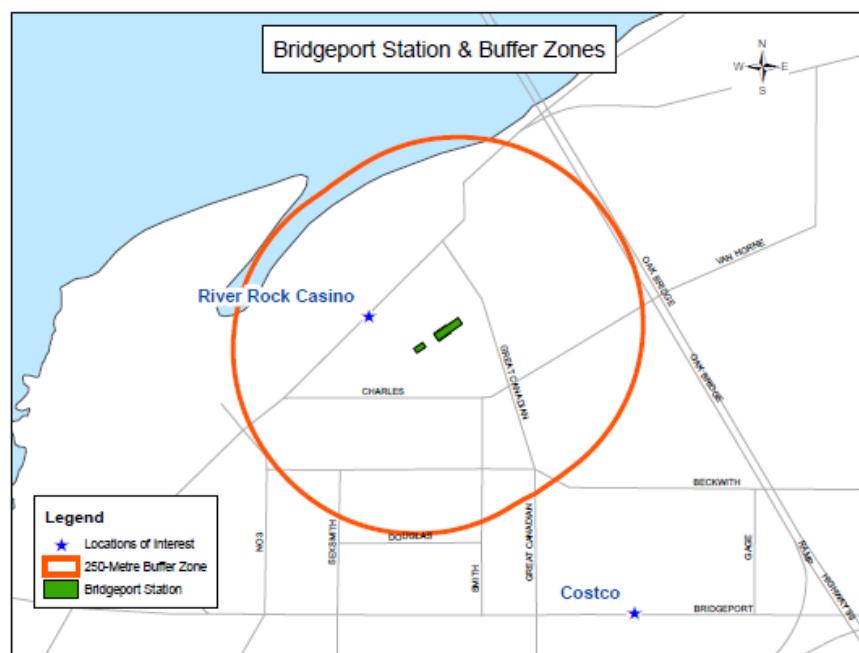
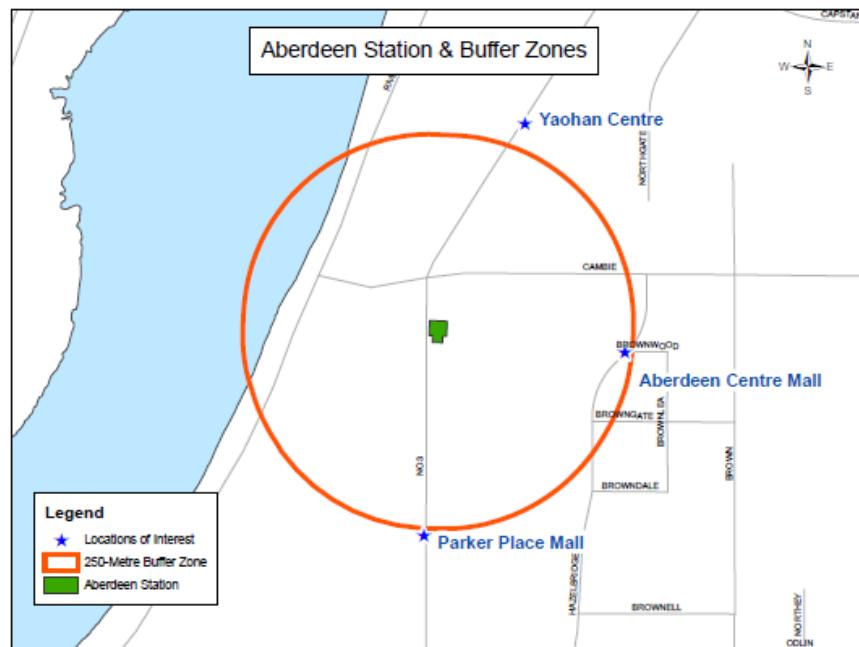
The findings of the current research highlight several important aspects in the construction and implementation of mass transit routes on crime. First, land use must be considered when planning new transit routes. Major activity nodes such as businesses, restaurants, residential buildings and car parks can attract or deter crime from occurring.

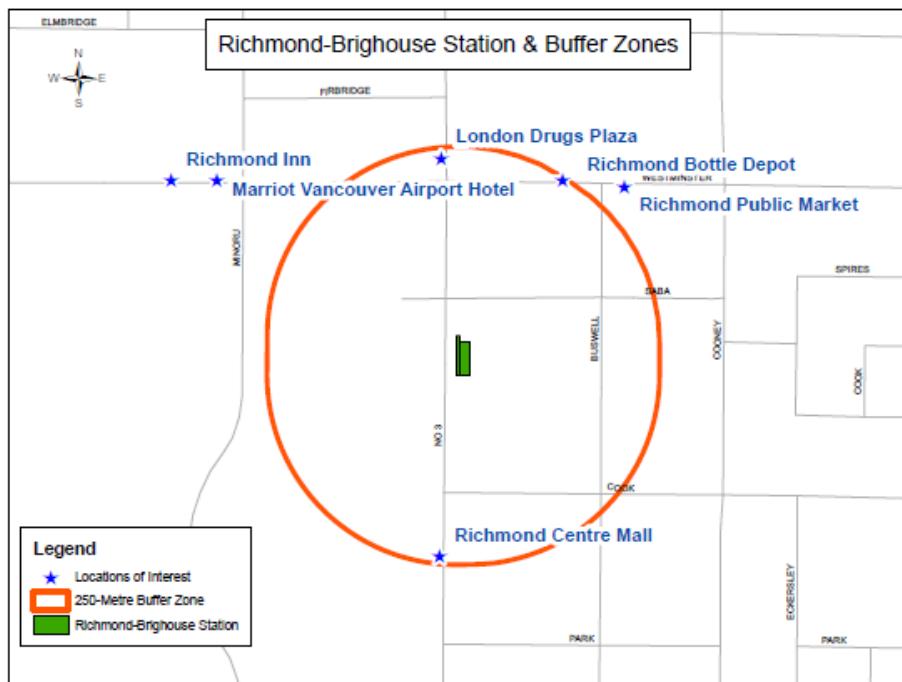
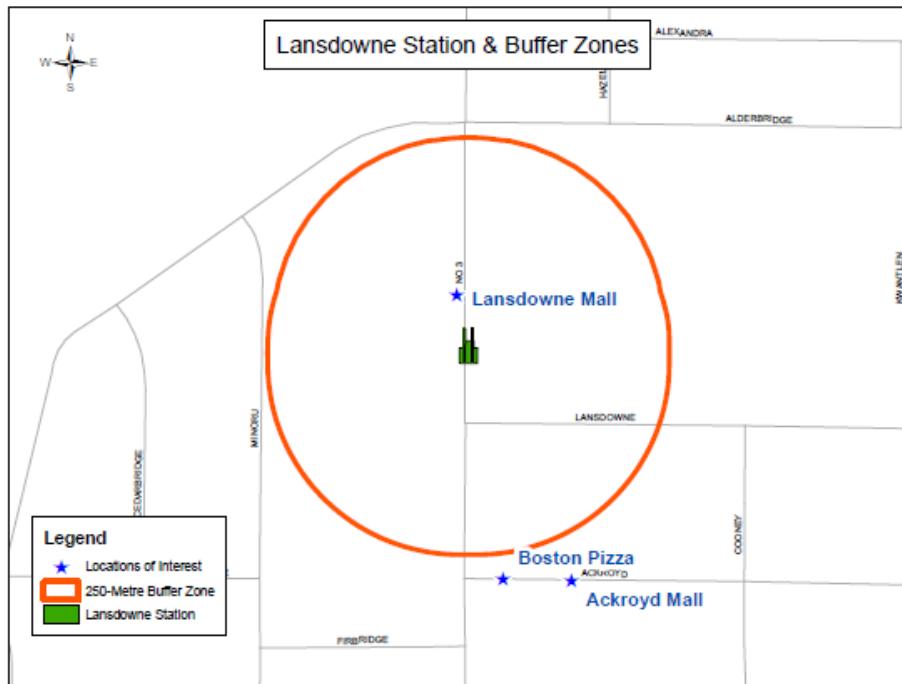
One must consider that particular establishments can increase the number and attractiveness of targets as well as the number of potential guardians to overlook and protect crimes from occurring. Furthermore, strategic planning must be included in preparation to handle mass mobile populations of commuters that contain both victims and offenders. More policing must be deployed to routinely patrol SkyTrain stations to deter motivated offenders from seeking out vulnerable targets commuting to and from work, school and leisure activities. Also included is the consideration of architecture. Through the principles of CPTED, city planners and local transit authority should work together to promote uniformity within transit stations to limit the number of criminal opportunities for offenders to seize upon. By providing limited seating space, fewer obstructing walls and an increase in both natural and mechanical surveillance, motivated offenders will be deterred from committing crime on and within public transportation.

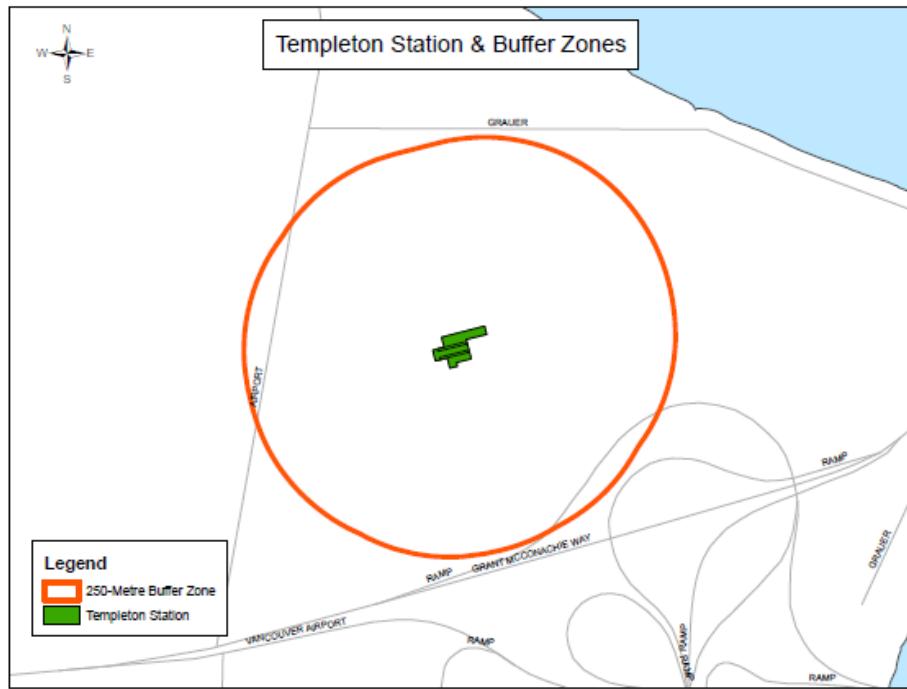
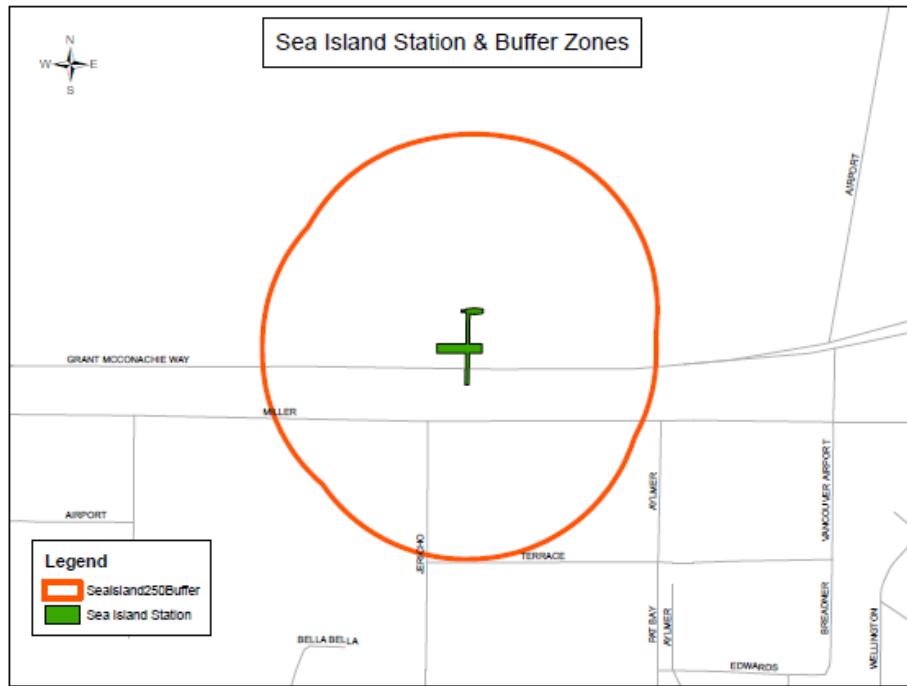
With approaches such as these to reduce and deter crime, formal and informal proactive responses can be created to assist both police agencies and the community to prevent transit related crime from occurring. Such preventive measures will help decrease both the level of offending as well as eliminate fears of expansion routes of public transit within the urban landscape.

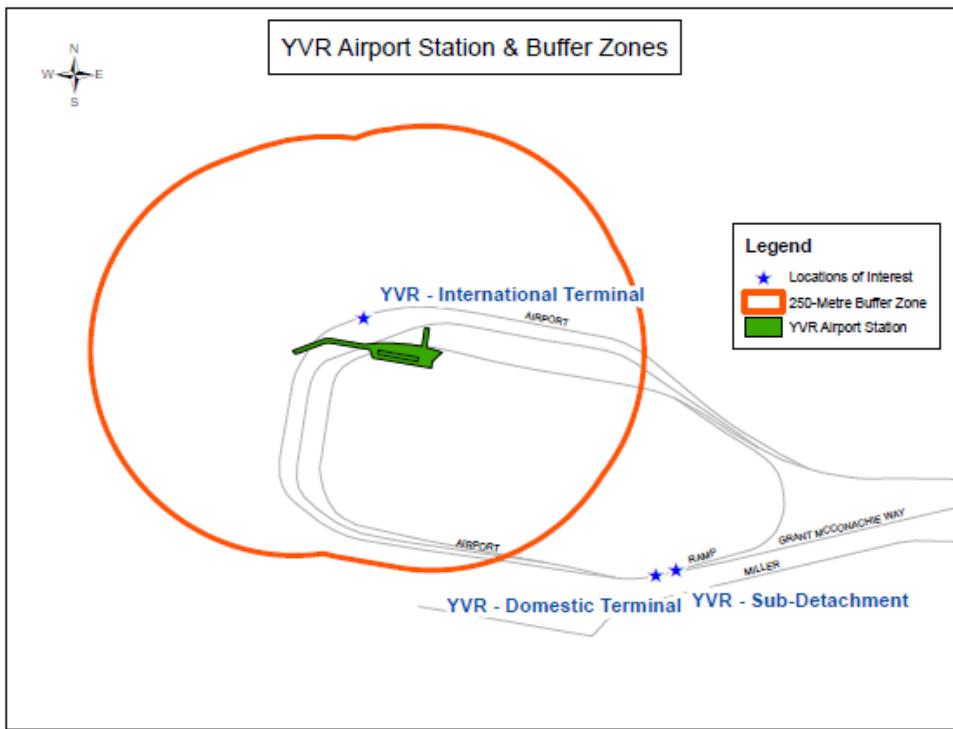
APPENDICES

Appendix A: Maps of Canada Line Stations in Richmond









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