HOW ARE STREET DRUG DEALING LOCATIONS SELECTED?

A SITUATIONAL ANALYSIS

by

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ABSTRACT

How Are Street Drug Dealing Locations Selected? A Situational Analysis

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In Newark, NJ, drug dealing is common, but it is not evenly distributed in every part of the city. Between 2007 and 2009, most drug arrests were made on less than 20% of the streets. The dissertation seeks to explain how the locations for drug dealing are related to their surrounding situational features. It is hypothesized that these features produce criminal opportunities for drug dealing activities: lack of guardianship, accessibility, and crime generators. This dissertation focuses on drug arrests at the micro-level – street segments and intersections. Police arrest records from 2007 to 2009 provided by the Newark City Police Department are analyzed. A matched case-control design is used. Applying a threshold criterion of 5 or more arrests, 104 street segments and 31 intersections having frequent dealing activity per year in 2007 to 2009 are sampled to be the cases. Controls are individually matched with the cases, taking account of their distance from the cases, street length, and the intersecting thoroughfares. The sample size is 135 pairs. Situational data of local drug dealing settings are observed using Google Street View. Inter-rater reliability is assessed to affirm the quality of the data. McNemar's test is employed to examine the correlations between variables and the drug market. The dissertation also sets forth a conditional logistic regression model to analyze the causal relationships between variables and the drug market. Results show that drug

dealing activity tends to occur on specific street segments characterized by abandoned buildings, bus stops, parking lots, vacant land, mailboxes, retail stores (near vacant lands), or the absence of a church. Drug dealing activity tends to occur on specific intersections characterized by parking lots, retail stores, and churches. The presence of a church as a crime generator to the occurrence of drug markets on intersections is one notable finding of this dissertation. The results signal that there are distinguishable situational factors affecting drug activity on streets and intersections, respectively. This dissertation demonstrates the feasibility of using Google Street View for future crime research. Policy implications are provided for making local drug markets more predictable and controllable to the police.

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EXECUTIVE SUMMARY

This is a study addressing places of crime, specifically those in which visible drug activity is taking place, and their environmental characteristics. Recent studies in criminology and crime prevention have indicated a greater concern with places where crimes frequently occur rather than the individuals who commit them. Crime events are not independent and unrelated, but rather are often clustered at specific locations. In Newark, NJ, drug dealing is common, but it is not evenly distributed in every part of the city. Between 2007 and 2009, all drug arrests occurred on less than 20% of the streets, while the rest of the city experienced no arrests. This dissertation seeks to answer where the drug markets are located, and what situational characteristics facilitate the occurrence of drug deals at specific times and places.

This dissertation originates from the *situational* perspective that emphasizes the context of crime and the opportunities in the immediate environment that the potential offenders could exploit. A review of the relevant literature on drug markets reveals a number of key situational characteristics that are associated with street-level drug markets. For example, Eck (1994) applied the rational choice and routine activities approaches to study drug markets in San Diego, CA, and identified that some commercial locations such as grocery stores, book stores, convenience stores, fast food restaurants, motels, and the like are situational indicators of a potential local drug market. Myhre (2000) applied the situational precipitator approach to observe drug markets around public housing in Washington, DC, and identified that a place containing visible drug paraphernalia, unofficial trash bags, open unclaimed land, and other factors were

powerful indicators of drug activity. These and other empirical studies have drawn attention to how and why crimes occur in certain places. This dissertation discomposes these key characteristics to examine how drug markets are ingrained in the local community and how drug dealers establish local drug markets.

Accordingly, this dissertation uses an "environmental criminology" approach to argue the importance of crime places. These complementary theories, which include the rational choice perspective, routine activity, and crime pattern theories, lay the groundwork for many studies on places of crime concentration. This theoretical approach is particularly suitable for studying the interactions between environments and individuals. In particular, three core concepts from environmental criminology are used as the foundation for linking situational components of street drug markets and place: the features of guardianship, accessibility, and crime generators. These three concepts are incorporated into a proposed "situational model of street drug dealing," which is established to rationalize how the situational characteristics in the environment produce criminal opportunities for drug-dealing activity.

An examination of the Newark drug arrest data between 2007 and 2009 shows that drug market locations were fairly consistent. It brings out the assumption that certain features in these locations may attract drug dealers to come for business. This dissertation hypothesizes that drug dealers choose a particular location to deal drugs because (1) the location lacks guardianship, which reduces the risks of police apprehension; (2) the location offers easy access and escape, which makes drug transactions easier for dealers to commit; (3) the locations generate opportunities that favor drug dealers' illegal conduct

and attract potential customers. Further, the dissertation hypothesizes that (4) these situational factors from the previous three hypotheses have different impacts on street segments as opposed to intersections. The goal of this dissertation is to test these four hypotheses.

The geographic units of interest are street segments and intersections. Traditionally, research on crime has emphasized two main units of analysis: individuals and communities (Sherman, 1995). Most crime prevention policies have also emphasized offenders and the communities they come from (Akers, 1973; Gottfredson and Hirsch, 1990). Only in recent decades, as data and computing power have increased, have researchers begun to explore smaller geographic units. Recent longitudinal studies have revealed that crime concentration across micro places is relatively stable over time (Groff, Weisburd, & Yang, 2010). Street segments and intersections are closely related to the activities of everyday life, but they are rarely mentioned in previous literature. Drug activity can crucially affect residents' quality of life; thus, understanding drug market activity at the level of streets and intersections may help to advance our understanding of crime. The street segment is used in this dissertation because it is a unit large enough to reduce the chance of coding errors in police data which are commonly associated with smaller units such as address, and also its implication could be generalized to other streets rather than just addresses. The intersection is used because it is a location where high flows of individuals meet and socialize frequently. This dissertation seeks to explain how the locations used for drug dealing are interrelated to the situational features of streets and intersections.

A matched case-control design is used to explore the differences in the physical environment of locations having frequent dealing activity (cases) and locations free of dealing activity (controls), using situational variables. Previous research has revealed that individual street segments have crime trajectories which are unrelated to their immediately neighboring streets (Groff, Weisburd, & Yang, 2010). This methodology allows this dissertation to compare how the locations with the most drug dealing activity (the cases) are different from the nearby locations free of dealing activity (the controls). Newark, New Jersey has been selected as the study site. Active dealing locations are operationalized and identified through an examination of the police arrest records from 2007 to 2009 provided by the Newark City Police Department. Applying a threshold criterion, locations in Newark having five or more drug arrests per year in 2007 to 2009 are selected to be the cases. 104 street segments and 31 intersections are thus sampled. Controls are individually matched with the cases, taking account of their distances from the cases, street lengths, and the intersecting thoroughfares. In other words, each control segment is located as close to its matched case segment as possible, and has similar lengths as the case segment; while each control intersection is located as close to its matched case intersection as possible, and shares a major thoroughfare. The case-control sampling procedures yield a sample size of total 135 pairs. Using this design enables each pair to have the most similar characteristics and background possible, except for the situational characteristics of interest.

Situational and physical environment data from street dealing settings are collected through the use of a relatively new online feature, Google Street View. Previous

studies often use observations or guesswork to analyze the inside world of the illegal drug market; this dissertation takes a different approach by aiming to identify situational factors grounded in the immediate surrounding of market locations that directly influence the operation of dealing activities. In the past, this type of neighborhood research commonly applied field observations to gather data on the physical environment; however, this method has been widely recognized to be very time-consuming and expensive (Clarke, Ailshire, Melendez, Bader, & Morenoff, 2010; Rundle, Bader, Richards, Neckerman, & Teitler, 2011). This dissertation introduces Google Street View as a cost-effective and promising alternative for data collection. Google Street View is a readily-available online tool that provides panoramic views of most of the streets in major U.S. cities. A coding instrument is established for collecting and collating the GSV observational data. Several field observations in the form of ride-along trips with the Newark narcotics unit officers were conducted along with the development of the coding instrument in order to identify any situational characteristics that are particular to Newark and absent from the previous literature.

To affirm the quality of the observational data to be analyzed, data reliability is examined via assessing the agreement in data observed by different raters. The "inter-rater reliability" is a measure for examining the agreement of coded data by two or more raters on the same variables. This dissertation examines three forms of inter-rater agreement – the raw agreement (as a reference), Cohen's *kappa* statistic, and the intra-class correlation statistic. The comparison of more than one reliability-check method will help in determining the items reliable enough to be observed by the GSV images. In this

study, a sub-sample of 30 street segments and 30 intersections is observed and coded independently by a colleague, and is compared with the author's coding. The independent verification is a critical factor in determining how well a coding instrument or measurement system works, and how reliable the GSV observational data is. In general, on street segments, virtual observations of abandoned buildings, bus stops, parking lots, vacant land, public facilities and retail facilities have high levels of agreement between raters. On intersections, virtual observations of bus stops, parking lots, vacant land, public facilities, retail facilities and churches have high levels of agreement between raters, and abandoned buildings have moderate level of agreement. These are the objects that can be clearly and reliably identified on the street images; thus they are used for further analysis.

McNemar's test is employed to examine the difference between cases and controls on the presence of situational factors of interest. The test examines the hypothesis that each of these situational factors is related to the presence (or absence) of a local drug market at sampled locations. The findings suggest that the prevalence of abandoned buildings, bus stops, parking lots, vacant land, retail facilities and churches on the case street segments, respectively, is significantly different from their prevalence on the corresponding control segments. On the other hand, the finding only indicates the prevalence of retail facilities on the case intersections to be significantly different from their prevalence on the corresponding control intersections. The findings would help us understand the effectiveness of controlling these situational factors in predicting drug activity in Newark for policy purposes. The dissertation also sets forth a multivariate

model to examine these situational factors, using the conditional logistic regression. The model examines the causal association between each variable and the presence of a street drug market. The findings suggest that abandoned buildings, bus stops, parking lots, and mailboxes can strongly explain the presence of drug markets on street segments, while churches can strongly prevent the occurrence of drug markets on street segments. In addition, when there are retail facilities near vacant land, the place is found to be significantly more vulnerable to drug dealing activity on street segments. The results also suggest that parking lots, retail facilities, and churches can strongly explain the presence of drug markets on intersections. Particularly, the presence of a church is found to be a crime generator that is associated with the occurrence of drug dealing activity on intersections.

This dissertation addresses several concerns and limitations encountered during the development of the research design. First, high-dealing locations are selected solely on the basis of the official police arrest records, meaning that any bias in the information in these arrest records may lead to inconsistencies in further analysis. Second, matching increases the efficiency of the study design by controlling the influence of the confounding variables, but it is possible that the matched controls still differ from the cases in unpredictable ways that could affect the causality (Shadish, Cook, & Campell, 2002). Third, using GSV for a virtual field audit is contingent upon a temporal alignment between the GSV images and the street data. GSV does not offer additional street images of the same street on a different date; thus, it only offers its utility within a limited time frame. Fourth, the intersection dataset is very small (N = 31 pairs), and statistical powers

are too low to allow strong statistical inferences. Therefore, results of the bivariate analysis on the intersection data is for information purpose only.

The goal of this dissertation is to offer practical evidence-based policy implications to local law enforcement agencies to control and reduce street-level drug crime. This dissertation expects to construct a guideline for situational profiling for local police. The importance of law enforcement in controlling local drug markets has been emphasized by the previous literature. Identifying these factors will help the police implement more effective situational prevention practices, minimize street drug dealing activity, and prevent the further development of local drug activity and collateral crime. The study is expected to have policy implications which will make local drug markets more predictable and easier for police to combat.

CHAPTER 1: INTRODUCTION

This is a study addressing places of crime, specifically those in which visible drug activity is taking place, and their criminogenic characteristics. Research over the past few decades has indicated a greater concern with places where crimes occur rather than the individuals who commit them. The purpose of this dissertation is to focus on the specific aspects of place. The dissertation aims to locate the environments in which drug dealing occurs, and what situational factors facilitate individuals to commit such activity at specific times and locations.

Illegal drug markets have been studied using a variety of approaches, including: ethnographic and qualitative observations, population-based surveys, economic analysis, behavioral and psychological aspects, and criminology and law enforcement perspectives. This dissertation takes a different approach, studying local drug markets from a situational perspective. This perspective differs fundamentally from other approaches that focus on understanding the background of criminals. The situational perspective asserts distinct emphasis on the environmental features that are associated with opportunities to commit crime. This perspective also explains the interactions between criminals and environments. Rather than looking at the towns in which the criminals grew up or looking at why drug activity is more rampant in specific cities, the situational perspective focuses on the immediate settings of criminal acts and seeks to make criminal acts less attractive to the potential offenders. More importantly, this perspective argues for preventing the occurrence of crime, and introduces discrete environmental and managerial measures to intervene, reducing opportunities for criminal acts that potential offenders would otherwise exploit.

Problem Statement

A drug dealer's motivation may be to make money quickly; however, the dealer's behavioral pattern is driven by situational risks. It is likely that dealers will choose certain locations to exchange drugs because these locations reduce the risk of apprehension, or provide more potential customers. If a kingpin is arrested or eliminated, another dealer in the market will soon fill his position. If a location is ideal for dealing drugs, then more dealers will likely keep coming into the area. Drug dealers decide where to locate their business based on the profit and security the location provides. This dissertation tries to untangle the specific factors involved in the above dilemma.

An examination of the police data on drug arrests made in Newark between 2007 and 2009 proves that the dealing locations were highly consistent. The findings indicate the necessity of considering how and where drug dealers initiate and establish a drug market. Thus, this dissertation seeks to identify the situational factors that characterize a local drug market, and the factors that attract the dealers to set up their business. It also seeks to identify the situational factors that facilitate the development of the drug market.

Literature Review

Most traditional criminological theories examine the individuals to assess the reasons certain individuals commit crimes and not others. This dissertation uses a different theoretical approach, environmental criminology, which argues for the importance of crime places – rational choice, routine activities, and crime pattern. These complementary theories, sometimes called opportunity theories, lay the groundwork for the many studies on locales of crime concentration. Routine activity theory addresses the chemistry of the offense, individuals, time, place, and opportunities that converge (Felson,

1986). Rational choice theory focuses on the decision-making and viewpoint of the offender, as to why the offender would rather commit a crime than take another action, why the offender commits the crime at the selected time and location, or how the offender interacts with the environment and the opportunities it presents (Clarke, 1992). Crime pattern theory constructs patterns of daily activities, and the crime opportunities generated alongside the patterns (Brantingham & Brantingham, 1993). The offenders' actions seem to be the direct result of opportunity. It seems that certain characteristics of these places offer opportunities favorable for crime; therefore, they draw drug dealers there for business.

A review of the relevant literature on drug markets reveals a number of key situational characteristics that are associated with street-level drug markets. For example, Eck (1994) applied the routine activities and rational choice approaches to study drug markets in San Diego, CA, and identified that some commercial facilities such as convenience stores, fast food restaurants, motels, and the like are indicators of local drug market activities. Myhre (2000) suggested a situational precipitator approach to observe drug activities around public housing in Washington, DC, and found that a place containing visible drug paraphernalia, unofficial trash bags, open unclaimed land, etc., may be powerful indicators of drug activity. Also, among the situational crime prevention literature, surveillance cameras, *culs-de-sac,* and other place-specific interventions were proved to be successful in deterring local drug markets. These and other empirical studies have contributed to making this trend of environmental criminology a scientific discipline, changing the focus of criminological research from why certain individuals commit crimes to how and why crimes occur in certain environments.

Research Design

Previous studies often use observations or guesswork to analyze the inside world of an illegal drug market; this dissertation takes a different approach by attempting to identify situational factors grounded in the immediate surroundings of market locations that directly influence the operations of dealing activities. The review of relevant literature suggests that drug-dealing locations are distinguishable from dealing-free locations on the basis of surrounding physical characteristics. A matched case-control design is used to explore the differences between the characteristics at dealing locations and dealing-free locations, using situational variables. It is hypothesized that the absence of guardianship (the routine activity theory), the presence of easy accessibility (the rational choice perspective) and crime generators (the crime pattern theory) in the physical environment produce criminal opportunities for drug dealing activities. Drug dealers choose locations in which these features are present and which they can exploit.

The study site of this dissertation is Newark, New Jersey. The geographic units of interest are street segments and intersections. Active dealing locations in Newark are identified through an examination of the police arrest records from 2007 to 2009 provided by the Newark City Police Department. This dissertation uses street segments and intersections as an operational definition of places. A street segment is defined as "the two block faces on both sides of a street between two intersections" (Weisburd, Bushway, Lum, & Yang, 2004: 290); it is used in this dissertation because the street segment is a unit large enough to reduce the chance of coding errors in police data which are commonly associated with smaller units such as residential address, and also its implication could be generalized to other streets rather than just addresses. An

intersection is defined as a location where two or more streets cross; it is used because it is a location where many inner-city residents meet and socialize frequently. Both street segments and intersections are often found to be linked to drug activity (Weisburd & Green, 1994); thus they are both included for analysis.

Similar to Weisburd and Green (1994), where the researchers utilize multiple data sources and different cutoff criteria to filter places evidencing repetitive drug problems, this dissertation uses a threshold criterion (at least five arrests in each year of 2007, 2008, and 2009), and 104 street segments and 31 intersections are selected to be the cases. Controls are individually matched with the cases, taking account of distance from the cases, street length, and major thoroughfare. This design is utilized to allow each case-control pair to have the most similar characteristics and background possible, except for the situational characteristics of interest.

Situational and physical environment data on the street settings associated with drug dealing are collected through the use of Google Street View. Previous neighborhood research has acknowledged that applying systematic social observation to gather physical environment data can be very time-consuming and expensive (Clarke et al., 2010; Rundle et al., 2011). This dissertation introduces Google Street View (GSV) as a cost-effective and promising alternative to collect the data. Google Street View is a readily-available online tool that provides panoramic views of most of the streets in major U.S. cities. Situational variables that are observable on GSV are collected. An assessment instrument (see Appendix) is established for coding and collating the cyber-observation data (Odgers, Caspi, Bates, Sampson, & Moffitt, 2012). Several field observations in the form of ride-along trips with Newark Narcotics Unit officers are conducted in conjunction with the

development of the assessment instrument in order to identify any situational characteristics that are specific to Newark and absent from the previous literature. For example, an unguarded cemetery may be used by dealers as a drop-off location but it is not well addressed by the literature. During the ride alongs, officers offered critical location-specific information about local drug markets, and several situational factors mentioned by them were later documented into the research plan of this dissertation. According to the results of Braga, Green, Weisburd, and Gajewski (1994), police perceptions are considerably accurate for assessing levels of drug activity in street drug markets. Thus, this dissertation adopts the narcotics officers as observers of drug market activity.

Implications

This dissertation provides several important implications for environmental criminology and crime-control policy. The theoretical underpinnings for this dissertation are the rational choice perspective, routine activity theory, and crime pattern theory. A model of the situational mechanism was developed on the basis of this foundation (see Chapter 5), which will be evaluated in further analyses. This proposed situational model would establish a better understanding of street drug-dealing acts and contribute to our understanding of these environmental theories. Another theoretical implication is to show that the field of environmental criminology is an ideal theoretical approach for studying drug dealers' exploitation of opportunities presented in their environment. It is also a suitable approach for exploring how they take advantage of the situation, and how they benefit from the unique features of the environment. In addition, previous crime researches on the importance of place are examined further by this dissertation. The tight

relationship of crime and place would predict stability in the concentration of crime at place, which indicates the fact that there are specific processes that draw crime to concentrate at particular places. The findings of this dissertation support such a proposition.

Drug dealing locations are of great interest because of the variety of crime policies directed at them. This dissertation explores several situational characteristics that the police may employ to control and disrupt local drug market concerns. Locations that have the most drug dealing activity are those located closely to interstate highways so the dealers can escape police apprehension easily (Rengert, Ratcliffe, & Chakravorty, 2005). It is assumed that locations with frequent drug activity may be eliminated if the physical environment is properly altered and the place is no longer favorable to drug dealers. The purpose of this dissertation is to test the above and other assumptions, in order to offer a very practical evidence-based recommendation to local police agencies to control and reduce street drug markets. The critical role of law enforcement in controlling local drug markets has been emphasized by previous criminal justice research. Identifying these factors will help the police implement more effective situational prevention practices, minimize street drug dealing activities, and prevent the development of local drug activity and collateral crimes. The findings provide pragmatic strategies for deploying police resources to effectively control local drug markets; in particular, the findings address that there are distinguishable situational factors affecting drug activity on streets and intersections, respectively. This dissertation expects to construct a guideline of situational profiling for local police.

Outline of the Study

This dissertation is comprised of eight chapters. Chapter 1 is an introduction to the dissertation; it provides the rationale for a study of drug dealing locations. Chapter 2 begins with a general description of a street-level drug market; it illustrates how street deals are conducted, how scholars differentiate types of drug market operations, and how street-level drug markets cause serious harm to the community. It provides a demographic overview of the study site, Newark, New Jersey. It then provides an aggregated examination of the city's crime data, and a picture of the local drug market problem in the neighborhoods of Newark, NJ. The chapter also provides a description of field audit trips and the information obtained, which were undertaken to connect and compare the general knowledge of street drug markets with the particular characteristics of the markets in Newark, NJ.

Chapter 3 begins with a brief review of the development of crime place research, including the forerunners of crime place research; the contributions of the Chicago School of Human Ecology; influential experimental findings that encouraged the trend of research on hot spots (e.g., Sherman, Gartin, & Buerger, 1989); radical changes in theoretical focuses from individual-oriented to place-oriented after the 1980s; and the emergence of research examining crime in smaller geographic units. This chapter then summarizes relevant literature from different theoretical foundations addressing the importance of the environment for explaining crime, especially the drug-dealing problem; this chapter discusses the broken windows concept, and more predominantly, recently popularized theories of crime named Environmental Criminology.

Chapter 4 is a review of the literature on the situational variables that favor street

drug activity. The purpose of this chapter is to capture all key situational factors and categorize these variables using different theoretical approaches. Thorough review of the literature indicates how past research has dealt with situational characteristics on similar topics, but as of yet no literature has been as heuristic and specific as this research intends to be. This chapter serves to bridge the gap between situational analysis and street-level drug activities at the micro-level: street segments and intersections. The chapter offers insight into what has been addressed in past literature and finishes with a Table listing the relevant situational factors of interest. Research questions are then formulated accordingly in the following chapter.

Chapter 5 proposes a structure for a situational model depicting the interactions of drug dealers and their immediate environments, based on an environmental criminology framework. It also describes the research questions addressed by this dissertation and the corresponding hypotheses established to examine these questions. Chapter 6 describes the structure of research design used to explore drug-dealing activity in Newark, NJ. Beginning with a description of the matched case-control design, the chapter discusses the sampling procedure, methods of data collection, variables, and analytical models planned. This chapter illustrates the many steps performed to identify active street drug markets in Newark as cases, followed by the selection of control locations free of drug deals that match cases on some confounding factors. Subsequently, this chapter implements the application of Google Street View to collect observational data and explores the potential of leveraging the potential of Google Street View as an alternative to the systematic social observation method. Multiple inter-rater agreement measures on the GSV data are assessed, and only the variables having high levels of agreement are

kept for further statistical analysis.

Chapter 7 demonstrates descriptive statistics and bivariate analyses to examine correlations between the situational factors and the presence (or absence) of street drug markets at the sampled locations, using McNemar's test. Then the chapter sets forth a multivariate model to analyze the observed GSV data on street segments, using the conditional logistic regression. These analyses test the hypothesis that these situational factors examined is significantly related to the presence (or absence) of a street drug market. The findings would help us understand the utility of employing these situational factors in predicting drug activity in Newark for research and policy purposes.

Chapter 8 addresses several concerns encountered during the formation of the research design. It addresses concerns over possible biases of the official data employed, and the precautions needed when implementing matched case-control design. It also addresses the difficulties of conducting the sampling process, and the feasibility of using Google Street View to audit environmental data. This chapter also describes the theoretical and policy implications anticipated by this dissertation. It is expected that the proposed situational model will develop a better understanding of street drug markets and contribute to our understanding of the environmental theories. This chapter suggests an extended application of micro-level unit, street segments and intersections, to study local drug markets. This chapter ends with several implications for current policing policy this dissertation makes, and suggestions for future research on this topic.

CHAPTER 2: STREET DRUG MARKET IN NEWARK, NJ

To untangle the problem of local drug market activity, it is important to first understand that different kinds of drug market vary greatly from each other. The dynamics of dealing activity in a private dwelling may be entirely different from an open exchange outside a high school. Different types of operation require different policing strategies. The focus of this dissertation is the open market, where drug deals are conducted visibly and publicly on the street. Newark, NJ is selected to be the study site, in particular because the city offers enough geography and a sufficient number of crime events to undergo a micro-level study.

This chapter offers a general description of illegal drug markets, and the types of drug market commonly acknowledged in the literature. This chapter then illustrates why Newark, NJ is selected to be the study site for this dissertation, followed by a series of preliminary field observations conducted in Newark to assess the feasibility of this dissertation project.

A Portrait of Illegal Retail Drug Markets

Illegal drug markets have been a problem for society for years, and there is no sign of decline in the problem. There are several detrimental effects associated with the use of illegal drugs, including mental health problems and physical harm. The use of illegal drugs also has social consequences such as broken families, unemployment, and violent crime committed to finance drug addiction. The neighborhoods where the drug markets are located suffer serious collateral damage, such as fear of crime, fighting between local dealers over business territory, and commercial downgrading and disinvestment of the area.

A legal retail market is commonly defined as an arrangement where dealers and buyers meet to trade the merchandise; an illegal drug market is similar. Drug buyers want merchandise and drug dealers want money. They must find ways to meet with one another to make exchanges (Eck, 1995). Unlike a legal retail market, illegal drug dealers and buyers face additional risks, like detection by the police (Eck, 1995). Dealers may conduct a transaction with an undercover police officer, which may result in an arrest. Buyers, on the other hand, risk buying drugs from undercover police officers or informants, and even possible victimization by the drug dealers. The dealers and buyers must find the equilibrium of profit, cost, and risk, as well as choose the right locations to conduct the transactions. Dealing meet-ups are arranged after the locations are discussed and decided. In other words, to make a drug transaction happen, the right location is a necessary feature.

There are several observable traits of an illegal retail drug market identified by the previous literature. One, illegal drugs tend to be far more expensive than comparable legal products (Kleiman, 1991). The dealers cannot openly advertise or trademark their products, so they increase the sale price for each transaction. The threat from law enforcement also complicates doing drug business, which increases the operating costs imposed on the dealers. Two, the quality of a package sold to the drug buyer is highly variable. In the absence of regulations protecting customers' rights, drug buyers have no assurance as to the content and purity of their purchases. Illegality in itself is also likely to suppress consumption, because illegal products are less reliable in terms of quality than legal ones (Kleiman, 1991). Three, drug buyers often spend a considerable amount of time and effort finding dealers (Kleiman, 1991). They make frequent purchases, and

spend a large fraction of their total personal budget on drugs. Four, the distribution system of drug products are found to be either pyramidal (cf. Gilman & Pearson, 1991) or free-market style (e.g. May, Harocopos, Turnbull & Hough, 2001), which are shown in Figures 1 and 2.

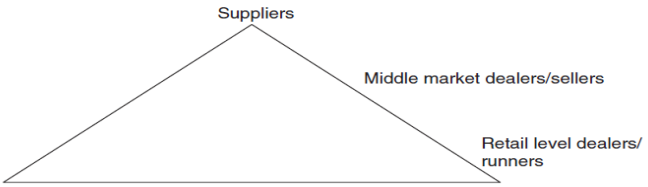

Figure 1 Drug distribution system: a pyramid-style market
Note: Drawn from May, Harocopos, Turnbull & Hough (2001)

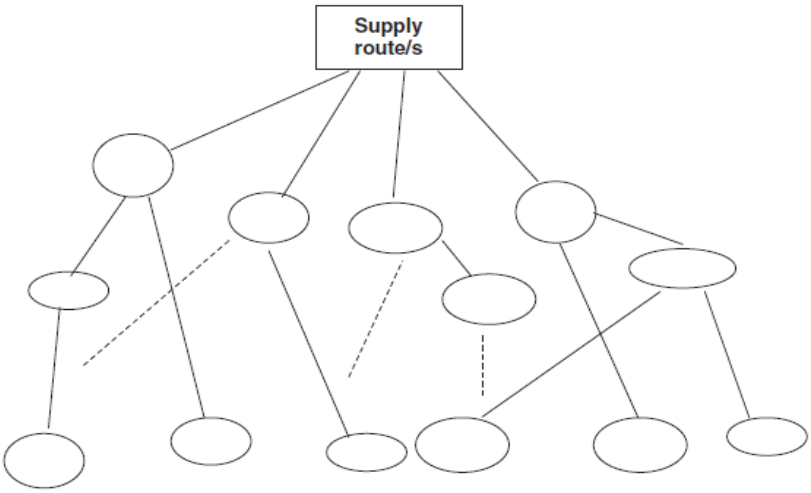

Figure 2 Drug distribution system: a free market
Note: Drawn from May, Harocopos, Turnbull & Hough (2001)

Five, the different types of drugs being dealt characterize the markets (Edmund et al., 1996). Different kinds of drugs result in different degrees of drug dependence, as well as different drug demands and sale prices. The "elasticity of demand" (the degree to which the drug buyer's willingness to buy fluctuates in response to changes in supply or

price) is likely to vary, and the drug prices are also likely to vary. Six, local markets often involve violence which results from aggressive interactions within the illegal drug market (Goldstein, 1985). Violence often occur when disputes over business territory, robberies from dealers possessing drug products, buyers failing to pay, disputes over transacting adulterated drugs, etc. Seven, the sustainability of any local drug market is often the result of its street reputation (Lupton et al., 2002). If the market survives the risks posed by police and other market competitors, it gains reputation and attracts more customers (Edmunds et al., 1996).

Eight, different forms of drug markets develop in neighborhoods of different racial compositions. For example, in stable neighborhoods with a predominantly white population, drug deals are often initiated through social networks and conducted indoors. Contrarily, rampant and visible drug activity is prevalent on streets in inner-city areas inhabited by a mix of ethnicities (Lupton et al., 2002); the buyers can easily come from outside the area, then quickly enter and retreat from drop-off points.

An Open Drug Market

To untangle the problem of the drug market, this section addresses the different kinds of drug markets that vary greatly from each other regarding their nature and dynamics. Many prior studies have attempted to categorize drug markets into types, and the classification is mostly based on the dealing location, time, and methods of business operation (for example, Eck, 1995; Rengert, 1996; Reuter & MacCoun, 1993). In general, three types are commonly acknowledged:

(1) Open market – drug dealing activities are visible on the street where drug sales are open to all strangers;

(2) Semi-open market – dealing activities are conducted in clubs and bars. The dealers know the customers to some extent, and they may sell drugs to both strangers and acquaintances;

(3) Closed market – dealing activities often take place indoors, where drug sales are open only to acquaintances. This type of market is very difficult for the police to detect. Thus, drug dealers in this market maximize their security but sacrifice the chance of maximizing their profits.

Prior research has proven that open drug markets tend to concentrate in space (Rengert et al., 2005). Drug transactions are highly concentrated geographically with a strong bias toward poor and disadvantaged neighborhoods (Kleiman, 1991). The concentration of drug transactions is almost certainly more concentrated than consumption (Kleiman, 1991). In an exemplary study of the heroin market in Manhattan, it was found that drug buyers chose to buy the products close to home, regardless of the fact that the same product was sold for half the price in another borough on the Lower East Side that was less than an hour away by subway (Kleiman, 1991). The demand of buyers getting products near where they live seems to map out local drug markets (Kleiman, 1991), just as the demand of grocery shoppers maps out supermarket locations.

It is possible that the concentration of drug deals at an intersection makes the search time shorter for the buyers; more importantly, the concentration decreases the risk posed by law enforcement for both the buyers and dealers. Kleiman (1991, pp. 10-11) argued: “Sellers cluster for the same reasons fish shoal and birds flock: protection from natural enemies, in this case the police. Since police routines tend to create a distribution

of officers which is more uniform than the distribution of illicit activity, being the sole dealer on a corner is far riskier than being one of twenty."

Thus, Edmunds and his colleagues (1996) have suggested that open drug markets are very "place-specific." An open drug market operates in geographically fixed locations at identifiable times, which allows dealers and buyers to easily locate each other (Harocopos & Hough, 2005; May, Harocopos, Turnbull, & Hough, 2000). Drug transactions within an open market are likely to take place in obscure places, where the environment offers enough protection to both dealers and buyers. This reveals that dealers select locations that are favorable to them. For example, there may be many small alleys inaccessible to cars and houses backing onto one another, which create quiet places for conducting drug transactions (May et al., 2000).

Open street markets can be the root cause for many other crimes in an area. Visible drug delivery and transactions are of greater concern (Boyum, Caulkins, & Kleiman, 2010; Kleiman & Smith, 1990). This is because this type of street-level drug dealer generates violence and introduces disorderly behavior into the community; furthermore, the discreet visibility of drug dealing on the street implies that the local law enforcement agencies are not capable of controlling the area, and the quality of life in the neighborhood is poor. It also implies that the drug businesses on the streets are openly accessible to potential and new users, and more violent offenses such as robbery and assault are more likely to occur (Boyum et al., 2010; Kleiman & Smith, 1990).

Why Newark, NJ?

An interest in the geographic distribution of street drug markets at a smaller geographic level initiated this dissertation's focus on searching for a single jurisdiction.

Newark, New Jersey makes a suitable research site for this dissertation because of the vast amount of high quality drug arrest data maintained by the Newark Police Department. The author's familiarity with the geography of the city and its data will also prove beneficial in providing a dependable and accurate analysis throughout this dissertation.

Geographically, Newark, NJ is the most populated municipal city in New Jersey, with a population of nearly 280,000, and is located about eight miles west of New York City. The southeast section of the city encompasses Port Newark and Newark Liberty International Airport, which are among the busiest cargo ports and airports in the U.S. In regards to the ethnic composition of the city, as of the 2010 Census data, about half (49.8%) of Newark's population was black or African-American, followed by Hispanic (33.8%) and white (11.6%). In terms of the city's socioeconomic composition, the city's median household income was estimated to be $35,507 in 2009, while about a quarter (24.3%) of Newark residents were estimated to be living below poverty level (U.S. Census Bureau, 2009 American Community Survey).

In Newark, NJ, there were on average 7000 drug-related activities caught on streets annually in the past few years. These drug dealers in open markets could not aggressively advertise their business, so they must have found other marketing strategies to make their whereabouts known to potential customers. In trying to maximize their revenue and, at the same time, ensure the security they need, the dealers have to look for transaction locations that conceal their activities and allow contact with many potential customers. A location that possesses these features may attract drug dealers, and creates a clustering of dealing activities (Eck, 1995).

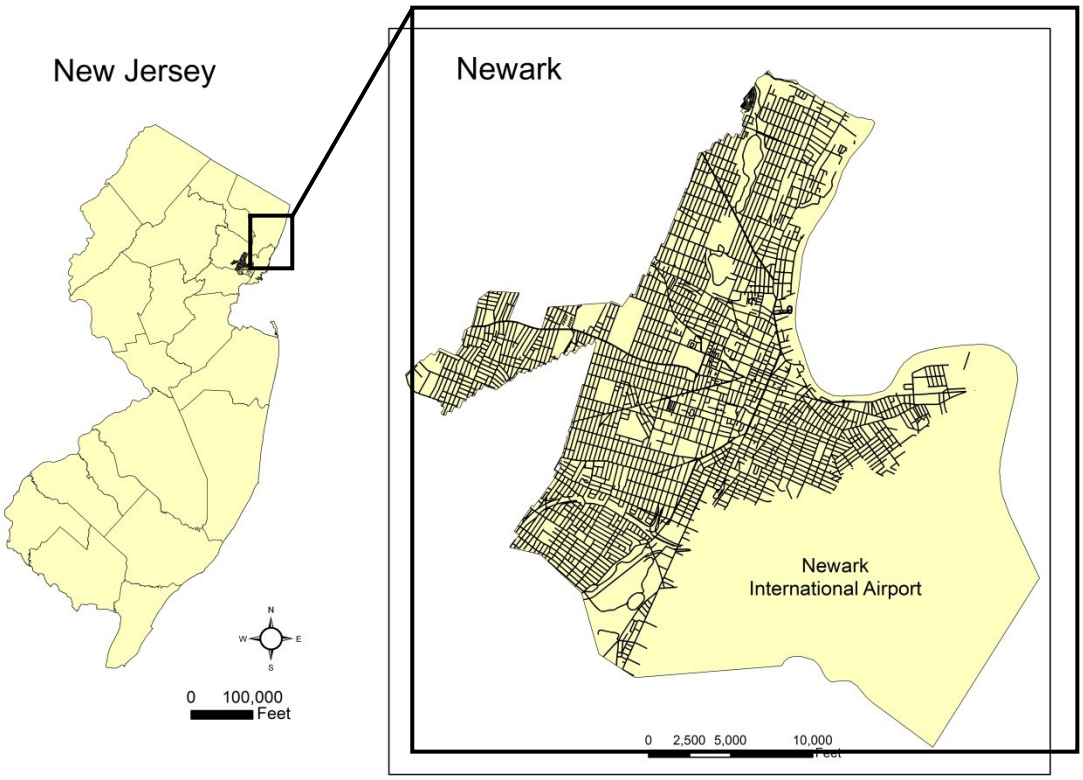

Figure 3 Newark in relation to New Jersey

As the most populated city in New Jersey, and its unique location bridging New York City and New Jersey, Newark offers an expansive geography, numerous crime events, and significant diversity to be utilized in a micro-level study. More importantly, the Newark Police Department maintains crime data well enough for the quantitative analysis in this dissertation to be conducted.

For example, in 2007, there were 6880 drug arrests made by the Newark Police, which was approximately 11.2% of the total arrests throughout New Jersey. Meanwhile, the Newark population was only 3.2% of the total population of New Jersey. Among the 3157 drug arrests made in Newark, a majority of the arrests were made on a few particular streets. For example, one street segment in the center of the city experienced

more than 100 drug arrests in 2007, compared to about 66% of all street segments in Newark that experienced no drug arrests at all in the same year. For another example, an intersection in the downtown area experienced more than 200 drug arrests in 2007, while about 60% of the intersections in Newark did not experience any drug arrests in the same year.

The drug-dealing pattern identified from the Newark data raises some critical questions: do streets with high degrees of drug dealing share any common environmental characteristics, compared to streets that are free of arrests? In other words, do these streets and intersections that have the highest degree of drug dealing activity attract such activity because they are locations that have certain physical features favorable to drug dealing? These questions suggest a need for research into the causes of these concentrations. This dissertation suspects that these locations in Newark were selected by the drug dealers to do business expressly because these locations offer security, access, and profit. Accordingly, this dissertation will further examine previous supporting literature and establish an analytical approach (see Chapters 3 to 6) with the goal of identifying the factors that influence dealers in selecting these locations.

Street Segments and Intersections

The street-situated dealing pattern described above raises an interesting issue: are the environmental factors of street segments different from the factors of intersections? In other words, is it likely that there are separate sets of situational factors favoring the occurrence of drug dealing on street segments as opposed to intersections? A general research question addressed by this dissertation is thus to interrogate whether drug-dealing activities have a different dynamic on street segments as opposed to intersections.

Streets and intersections are closely related in terms of every individual's daily life activities; thus, drug activities can crucially affect the quality of life of the residents. For this important reason, this dissertation examines street segments and intersections, and explores the causes for why certain streets and intersections suffer significantly more drug dealing activity than other streets and intersections. Interestingly, there has to date been no literature comparing situational factors in drug markets on street segments versus intersections. These geographic units are relatively newer units of analysis in crime research (Braga, Hureau, & Papachristos, 2011; Braga, Papachristos, & Hureau, 2010; Weisburd et al., 2012); thus, the findings of this dissertation will contribute to the understanding of drug dealing activities in these smaller geographic units.

Preliminary Field Observations in Newark

This section describes the process by which the author initiated the field observations in the form of ride-along trips with the narcotics unit officers from the Newark Police Department. This section also discusses the author's observations of the streets, especially the ones notorious for having repeated illegal drug activity. The purpose of these field observations is to familiarize the author with Newark. Because this dissertation will later collect observational data on local drug markets (see Chapter 6), these field observations will help the author construct a data coding instrument more specific to Newark.

Part of the design of the field observations can be referred to the problem-oriented policing report addressing drug-dealing problems in apartment complexes in Newark, conducted by Zanin, Shane, and Clarke (2004). At the start of this study, the author was taken to sites of street drug markets as perceived by the police officers, and to identify

common physical features in the environments by observing and drawing on the officers' knowledge of local drug activity. Newark narcotics officers' suggestions and opinions are considered in this study when suitable. Although some scholars argue that police officers' perceptions are subjective (Fagan, 1990; Monahan, 1981) and are unreliable measures of criminal activity, the findings from Braga and colleagues (1994) suggest that using police officers as observers of local drug market activity is promising. Police officers develop particular ways of interpreting their work environments through day-to-day observations and experiences, and are especially attentive to signs of abnormality (Bittner, 1970). Even though the degree of precision of their observations is limited, such observations are found to be valid. Police officer's assessments of street drug activity based on observation are generally consistent with official police data on the levels of drug crime activity (Braga et al., 1994).

Between March 2012 and July 2012, the author was developing the research methodology. The author contacted the Newark Police Department with the objective of working with the officers who patrol and are very knowledgeable about the places with frequent drug activity. With the assistance of the Police Institute at Rutgers University, especially from its Violence Reduction Initiative Director and the Community Outreach Coordinator,[1] the author was able to contact the Newark Police Department.

The Newark Police Department runs a Citizen Ride-Along Program, which offers community residents the opportunity to sit in the police patrol car to participate in and observe the work the police are doing for the city. The author submitted the Department's

[1] Bryan Morris, the Director of the Newark Violence Reduction Initiative of the Police Institute at Rutgers Newark, and Lori Scott-Pickens, the Director of the Community Outreach/Community Based Learning at Rutgers Newark, helped to initiate the communication between the author and the Newark Police Department.

Citizen Ride-Along Program Application Form to the Program Supervisor, and obtained authorization from a department lieutenant. The author was granted multiple ride-along trips with Narcotics Unit officers to drug-ridden neighborhoods on their regular patrols. Beginning mid-April, the author spent several weeks on ride-alongs with five Narcotics Unit officers patrolling the streets in Newark. The duration of each trip varied from 2 hours to 3.5 hours, depending on the assigned schedule and unplanned extra tasks the officers received during the day.

The author carried a list of situational indicators identified in the drug market literature (refer to Table 1 in Chapter 4) during the ride-along trips. The author asked the officers their opinions on the linkage between these indicators and local drug activity. The goal was to identify any situational factors that are particular to Newark and have not yet been acknowledged by the existing literature. The conversations with the narcotics officers were very constructive in regards to the development of the research methodology. The ride-along opportunities offered the author the opportunity to draw on the officers' knowledge and experience. The main goal was to obtain experienced officers' personal viewpoints and opinions on how the physical feature of Newark can influence the geographical distribution of street drug activities.

Based on the information gathered during the ride alongs, there were several dominant types of drug arrest scenarios:

- Undercover police cars randomly saw suspicious activity among two to three persons on the sidewalk next to a parked truck. Once the police stopped the crowd and searched their vehicle, a large amount of illegal drugs and paraphernalia was found inside their vehicle.

- During the “direct-patrol” routine, the undercover patrol car targeted intersections which were well-known to be the go-to locations to buy drug products.
- During routine check-ups on known drug offenders, the police officers approached the crowds in front of a public housing building. The officers questioned the individuals about why they were there, conducted body searches, checked their possessions, and communicated with the dispatcher to look for any outstanding search warrants on them.
- The undercover patrol cars stopped a speeding car that just exited from the highway and was driving into a neighborhood. The stop occurred because the officers believed that, from their personal experience, these speeding drivers from outside the city were likely rushing into the area to buy products and then retreat.

These field observation trips gave the author a general picture of drug dealing activity in Newark. First, it seemed that street drug markets in Newark were similar to the drug markets in other cities that had similar socioeconomic levels and ethnic composition; for instance, the drug markets in Willingham, Delaware (Rengert et al, 2005). Second, dealers tend to be located in a crowd; for instance, the crowd often gathered in front of a convenience store.

The information gathered from these and other trips also revealed several interesting points particular to Newark. It was often found that crowds of known drug offenders gathered on the front stoops of apartment buildings or the retaining walls surrounding communities. They were also frequently found hanging around public payphones or mailboxes. According to the officers, dealers used the public payphone or mailbox as a drop-off spot after a transaction was scheduled. Moreover, criminals were

sometimes caught committing crimes inside an unguarded cemetery. The narcotics officers believed the criminals were either stealing from the graves or picking up drug products left by the dealer.

Figure 4 Front stoops and retaining walls

In addition, as mentioned before, the author asked the narcotics unit officers about a list of situational indicators during these field observation trips. Interestingly, in addition to the above and other observations, the narcotics officers did not agree with some situational factors highlighted in the literature (see Table 1). For example, the bus stop was noted in past literature to be a significant factor related to drug dealing activity, because the passengers getting on and off the bus and pedestrians passing by are natural masks covering the exchanges between the dealers and the buyers. The buyers may arrive at a stop to quickly purchase the products, and then get back on the bus to leave the scene. However, this scenario may not apply to Newark, according to the narcotics officers. The officers also stated that, a few years ago, many bus stops in downtown Newark were frequent dealing spots, and because of their notoriety, the police put effort into disrupting the dealing activities around these bus stops. These drug markets soon reacted and relocated to other places – mainly into residential communities, such as inside apartment buildings or in alleyways between houses.

There were also some concerns that arose during the ride-along field observations. It should be noted that all the ride-along trips were conducted during the daytime; however, it is likely that many street-dealing activities occurred at night. Thus, it seems critical to examine the times (of arrest) in the data studied to verify the times when dealing activities most frequently occurred. In addition, further information is greatly needed regarding the drug markets and local communities. However, because of the departmental regulations of the Newark Ride-Along Program, the author was permitted only five trips with the officers. A second request to the Newark Police Department was sent to the director of the Ride-Along Program late in mid June 2012. About one year later in June 2013, the author was contacted by the Newark narcotics officers and was granted another five ride-along trips with the officers.

Table 1 *Additional situational factors identified during field observations*

Situational Factors	**Function**	**Suggested by Newark Officers**	**Observed by the Author**
Cemetery	• Offenders steal from graves • Buyers pick up drug products left by the dealer	Yes	
Apartment Front Stoops	• Crowds of known drug offenders gather here exchanging information		Yes
Retaining Wall	• Crowds of teenagers hang out here exchanging information		Yes
Mailbox	• Dealers use the mailbox as a drop-off spot after a transaction is scheduled	Yes	

Later in mid June, the Community Outreach Coordinator of the Police Institute from the Rutgers University agreed to work with the author. The author provided a list of locations where drug arrests were frequently made by the Newark Police. The community

outreach coordinator drove the author in an unmarked car observing the surroundings of the locations according to the list (Figures 5, 6, and 7 show some of the situational factors detected during the field observations). This field observation took two hours, and the author was able to make more observations and gathered more opinions from her.

Figure 5 Mailbox and vacant land at intersection

Figure 6 Abandoned building and vacant land at intersection

Figure 7 Retail store, bus stop, and abandoned building on street segment

It should be noted that the narcotics unit officers have strong prior knowledge about the streets, and strong preferences regarding where to patrol in the city. Thus, the observations made are more likely to intensify the correlations between the situational features and the environments. On the other hand, the community outreach coordinator was driving the author to known drug activity locations according to the list; thus the observations made about the city are focused only on drug-related locations, rather than the city in general.

Summary of the Chapter

This chapter gives a general picture of illegal drug markets described in existing literature, and specifically discusses the "open drug market," as it is the focal point of this dissertation. It reveals that illegal drug activity at the street level visible to the public seems to be the greatest concern to the local community, the police, and society. This chapter then illustrates why Newark, NJ, is selected to be the study site, followed by the discussion of the field observation trips in Newark to assess the feasibility of this dissertation project. These field observations suggest that drug markets in Newark seem

to be similar to the descriptions of drug markets in other cities; nonetheless, there are several situational indicators found to be specific to Newark, like front stoops and cemeteries. These observations suggest a need to study these open drug markets in the context of its locale and local dynamics. The purpose of the dissertation is to understand the nature of this specific form of local drug market and the role it plays in the local context. More importantly, the purpose is to offer local law enforcement agencies more effective drug-control strategies.

CHAPTER 3: CRIME PLACE RESEARCH AND THE SUPPORTING THEORIES

For decades, criminal justice research has focused on the nature and causes of individual offending. Often, there are a few offenders responsible for a disproportionate amount of crime (Wolfgang, Figlio, & Sellin, 1972), and researchers attempted to discover the causes (for example, Chaiken & Chaiken, 1982). In the last three decades, the development of criminological research has radically diverged and its attention expanded from individuals to places and from larger to smaller units of crime geography. To study why individuals commit crime at particular locations, and to further understand the linkage between areas and the individual, it is critical to first clarify the linkage between the *place* and specific crime situation (Block & Block, 1995). This chapter lays out a brief history of crime and place research, the concepts of crime concentration, and the emergence of a focus on the geographic unit of analysis – street segments and intersections. This chapter then discusses the theoretical foundations that support the large body of research on crime, place and opportunity which facilitates this dissertation.

An Overview of Crime Place Research

1. The Emergence of Research on Crime and Place

The history of the study of crime and place can be traced back to the early 19th century. It is acknowledged that French scholar Andre-Michel Guerry (1833) and Belgium statistician Adolphe Quetelet (1842) are among the earliest researchers that analyzed geographical distribution of crime across regions such as countries, provinces, and *quartiers*. They examined social and ecological characteristics, such as poverty, inequality, population heterogeneity, etc., and how they affect the level of crime.

In the 1930s, a group of sociologists from Chicago, consisting of Robert Park, Clifford Shaw, Henry McKay and others, undertook a new trend in research on urban problems centering on crime (Bulmer, 1984; Faris, 1967). These Chicago School theorists moved the focus of crime and place research from broader areas to the units of cities and neighborhoods. They examined the dynamics of crime events around the metropolitan area of Chicago, and how the crime events interact with the locations. As argued by Park (1925 [1967], p.3), urban life should be studied in the context of its "physical organization," its culture, and the changes therein. This type of early research asserted that the urban environment of communities or cities is a critical factor in the occurrence of crime.

The Chicago studies inspired researchers to carry out empirical studies of crime and place in other cities. However, empirical and methodological critics of the Chicago theory began to emerge (Lander, 1954). Criticisms directed at data bias and ecological fallacy diminished the attention paid by researchers to the study of crime and place for nearly 20 years (Weisburd, Groff, and Yang, 2005).

In the 1980s, Albert Reiss encouraged a group of new researchers to return to the ideas of the Chicago School of crime. He saw the criminological tradition was dominated by two major positions, one focused on individuals and the other on crime itself. He sought to rekindle criminological interest in understanding the relationship between communities and crime (Reiss & Tonry, 1986), and variations of crime within and across communities. Research in crime and place has re-emerged since then. More importantly, this new trend of research on communities and crime has often led to the study of much smaller geographic units of analysis than the community as the unit level (Weisburd et al.,

2005). Among these studies in the U.S., utilizing census tracts or smaller census group data blocks have become the main sources for defining the geographic units of place (Rengert & Lockwood, 2009).

Meanwhile, the mainstream explanations of crime were still dominated by focuses on individuals and larger areas, such as communities, as the units of analysis. Studies on crime and place were relatively limited, compared to individual and crime research. One reason for this bias is that place data was not widely available below the census-tract level; yet another reason is the lack of consistent theoretical explanations in micro-place studies as contrasted with research on individual criminality, or crime at macro units (Weisburd & McEwen, 1997; Weisburd et al., 2004).

Such attempts to theorize crime and place largely emerged in the 1980s, when the work on routine activities (Cohen & Felson, 1979; Felson, 1994), offender's decision making (Cornish & Clarke, 1986), situations (Clarke, 1983, 1992), environments (Brantingham and Brantingham, 1981, 1993), and the spatial distribution of crime (Sherman, Gartin, & Buerger, 1989; Eck, 1994) redirected this trend and resulted in the radical turn of criminological focus to a new unit of analysis: place. These theories are briefly introduced as follows, and will be examined in detail in the next chapter.

The routine activity theory (Cohen & Felson, 1979; Felson, 1994) introduced the concept that a few critical elements are required for a crime to happen: a likely offender, a suitable target, and the absence of guardianship. Not only is a motivated individual necessary for a crime to happen, a suitable target must be readily present in an unguarded setting when the individual takes the action, providing the individual with the opportunity to commit the crime. The convergence of these three ingredients is necessary to produce a

crime event. The routine activity theory provides strong explanations as to why some places are repeatedly crime-prone, and it provides clear implications for crime prevention. Around the same time, Clarke and other British researchers began to explore the practical possibilities of situational crime prevention in the 1980s (Clarke, 1983, 1992, 1995; Cornish & Clarke, 1986). These efforts are structured based on the work of urban planners since the 1960s. Tracing back to the research pioneer Jane Jacobs (1961), who studied the correlation between crime and urban planning infrastructure, scholarly literature began to understand crime in terms of the surrounding environment rather than the individuals involved. Jacobs (1961) advocated the linkage between crime and the layout of streets and land use. Newman's (1972, 1975) *defensible space* ascertained that large-scale housing projects discourage residents from practicing territoriality and taking responsibility for public areas. Jeffery's (1971) *crime prevention through environmental design* strongly advocated modifying the design of housing developments. This environmental intervention approach illustrated how changes in the physical environment of a place can alter criminal activity, improve security, and can naturally change the distribution of crime.

2. Eck and Weisburd's "Crime Places and Crime Theory"

Rather than viewing crime and criminality as two competing explanations of the crime problem, Eck and Weisburd (1995) suggested treating these two explanations as complements to each other. There may have been plenty of good explanations for the development of offenders, yet there is still a need for a good explanation for the development of crime events. Central to this idea is the concern with "place." A highly motivated offender does not necessarily embark on a crime event unless a place is

interpreted by the offender as suitable and utilized for the crime action. In an attempt to construct a theory of crime places, Eck and Weisburd (1995) summarized five different types of research from the early crime place literature (see Figure 8). Three types of research use the place as a unit of analysis, attributing crime events to problematic places. The other two types examine the offenders but nonetheless focus on how motivated offenders choose places for criminal acts.

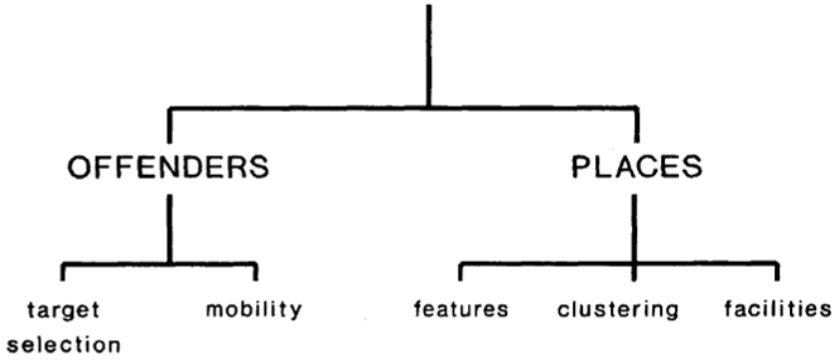

Figure 8 Studies of crime and place
Note. Source: Eck & Weisburd (1995)

(1) Facilities and Crime

Facilities are structures designed for specific purpose and functions. This type of literature examines facilities such as high schools, apartment buildings, churches, and convenience stores. This type of literature looks at how different kinds of facilities increase or decrease crime in their immediate environment, or how the facility may attract offenders onto a street block. Or it looks at the attractiveness and accessibility of targets in the facility, or the level of guardianship at the site. For example, Roncek and his colleagues conducted a series of studies on facilities and crime, and they found that bars and high schools are linked to a higher level of crime on the street blocks in which they

are located (Roncek, 1981; Roncek & Bell, 1981; Roncek & Faggiani, 1985; Roncek & Lobosco, 1983; Roncek and Meier, 1991; Roncek and Pravatiner, 1989).

(2) Site Features

Some sites are more criminogenic than others. This type of literature looks at why some places tend to attract people or motivate offenders to gather, why these places are the hangouts of deviants, or whether there are features of these sites attracting offenders from the surrounding areas. These features may include easy access to the site, lack of guardianship or proper place management, and the presence of readily available valuables (Eck & Weisburd, 1995). This type of literature addresses the importance of improving surveillance. For example, Newman (1972) suggested that improving the defensible space features around public housing projects enhances the residents' sense of territory and informal social control. Mayhew (1981) suggested improving surveillance inside convenience stores can prevent crimes. Other studies suggested that controlling access to these sites, such as implementing physical barriers and security screens, resulted in fewer robberies at banks or post offices (Grandjean, 1990; Ekblom, 1987).

(3) Clustering

Crime is heavily clustered in a few "hot spots" (Sherman et al., 1989) – repeat events occur at the same place. This type of literature addresses the fact that crime is not evenly distributed across an area, but rather concentrated in some places and not others. A few locations in an area often have a disproportionately high number of crime events. Some of the original evidence for the geographic clustering of crime was found in studies in Boston (Pierce, Spaar & Briggs, 1988) and in Minneapolis (Sherman et al., 1989). Pierce and colleagues (1988) assessed calls-for-service data and found that a few street

addresses in Boston produced the most repeat calls (accounting for over 60% of all calls reported to police). Sherman and colleagues (1989) analyzed about 323,000 calls to the police and found that a small number of addresses and intersections (5% of the 115,000 street addresses and intersections examined) were responsible for the majority of the predatory crimes (100% of the calls) in Minneapolis.

Such clustering also occurs on specific types of crimes (Eck & Weisburd, 1995). For example, Weisburd and Green (1994) identified drug offenses clustered around street segments, yet each operating drug market had a clear geographic boundary. The literature on clustering also suggests that crime prevention implementations would be effective based on the knowledge of crime clustering at the identified places (for example, Forrester, Chatterton, & Pease, 1988).

(4) Offender Mobility

Offenders move around and crime may occur in a variety of settings. Place and movement are essential to the understanding of crime events (Eck & Weisburd, 1995). This type of literature examines two aspects of mobility – distance and direction (Eck & Weisburd, 1955). Some studies examine the distances travelled by offenders from homes to crime sites, and the distribution of crime events as they move further from their homes (Capone & Nichols, 1976; Phillips, 1980; Rhodes & Conley, 1981). Weisburd and Green (1994) found that drug markets in an area had distinct boundaries, indicating that the offenders were cautious about their territories and mobility. Some studies examining direction address that offenders tend to move towards areas rich with valuable targets (Boggs, 1965; Phillips, 1980; Costanzo, Halperin & Gale, 1986). This type of literature also addresses the fact that the search areas of offenders seem not to be random; rather,

the offenders have cognitive maps (mental interpretations of their surrounding) when selecting places for crime.

(5) Offender Target Selection

Offenders are rational, but their rationality is often bounded (Rengert & Wasilchick, 1990; Feeney, 1986; Kube, 1988; Maguire, 1988; Cromwell et al., 1991). This type of literature looks at how offenders select crime sites in accordance with their point of view, mostly by interviewing them. For example, some studies found that offenders often seek opportunities while engaging in their routine, daily legitimate activities (Brantingham & Brantingham, 1981; Rengert & Wasilchick, 1990). It also indicates that places with high levels of crime are likely to be easily accessible, such as on major arterial roads, or where illegal behaviors can easily blend in.

3. The Emphasis on Micro-Level Places

Careful definition of the units of analysis is critical to our understanding of crime hot spots (Bursik & Grasmick, 1993; Weisburd, Bernasco, & Bruinsma, 2009). Hot spots of crime have been vaguely defined (a "small area" containing disproportionately large numbers of incidents). Commonly when crime is concentrated at a place, such a place is seen as a hot spot. The concentration might be a cluster visually identified on a pin map, or a density cluster identified arbitrarily by mapping software. Recently, there is a growing attention in the literature on crime place to the notion that the unit should be very small and specific (Braga & Weisburd, 2010; Brantingham, Brantingham, Vajihollahi, & Wuschke, 2009; Groff, Weisburd, & Morris, 2009; Taylor, 1998). In an effort to achieve such specificity, a few studies attempted to provide classifications. For example, a hot spot may be a very specific type of geographic aggregation, such as a

cluster of buildings, household addresses, block faces, or street segments (Block, Dabdoub & Fregly, 1995; Eck & Weisburd, 1995; Sherman & Weisburd, 1995; Weisburd & Green, 1995). Ratcliffe (2004) differentiates types of geographic clustering into hot dots, hot lines, and hot areas.

Sherman and colleagues (1989) coined the term "criminology of place" to describe this new trend that attempts to incorporate its theoretical grounding from routine activities and situational crime prevention to emphasize the significance of micro-level places in our understanding of crime. Sherman (1995) addressed that the variation in the "criminal careers" of specific places can be better understood at the level of place, rather than the individual. Spelman and Eck (1989) also found that crime concentration at repeat places is more intensive than it is among repeat offenders. Among these and other influential studies, the focus in crime control and reduction research was shifted from individuals to a focus on place.

As early as the 1960s, ecological psychology in particular had already attempted to understand how places function and how place-users interact with the built environment (i.e. Barker's "behavioral setting theory" in 1968). These researchers recognized the relevance of street segments in organizing life in the city (Jacobs, 1961; Taylor, Gottfredson, & Brower, 1984), and the built structure of a street segment can influence individual's behavioral patterns and the types of activity on that segment (Taylor, 1997, 1998). Recently, criminologists began to notice the potential of using street segments in understanding crime place, rather than household addresses. Street segments, sometimes called street block faces (Eck, 1994), are defined as "the two block faces on both sides of a street between two intersections" (Weisburd et al., 2004: 290). The street

segment is a particularly useful unit of analysis for studying crime activities (Weisburd et al., 2009), and also a useful analytical tool for policing places (Sherman & Weisburd; 1995). One reason for this is the close proximity and visibility of block residents, certain shared common behaviors, and interrelated role obligations; additionally the tangibly defined physical boundaries of a street make the street segment an easily identifiable geographical unit (Taylor et al., 1984). A second reason is that a street segment is a unit large enough to minimize the effects of coding errors in official data that are commonly associated with a smaller unit such as address (Klinger & Bridges, 1997; Weisburd & Green, 1994; Weisburd et al., 2004). A third reason is that street segments are small enough to avoid aggregated information that might hide micro-level specific place patterns, a problem commonly associated with a large unit such as communities, regions, or cities (Braga et al., 2011, 2011; Braga et al., 2010).

Few criminal justice inquiries have explored the potential of using intersections as the geographic unit for analyzing crime (Sherman et al., 1989; Weisburd & Green, 1995; Braga et al., 2011, 2011; Braga et al., 2010). Intersections, or street corners, are defined as locations where two or more streets crossed. Several previous studies excluded crime incidents at intersections from the analysis due to technical difficulties (Weisburd, Lum, & Yang, 2004; Weisburd, Groff, & Yang, 2010). Weisburd and Green (1994) noted that drug dealing was often linked to intersections; thus, they included both segments and intersections as analytical units. Intersections may be a substantial element for analyzing crime place. Several sociological studies have found that some inner-city residents meet and socialize for a significant portion of their daily lives on intersections (e.g. Liebow, 1967; Whyte, 1943). It is also found that robbers are attracted to particular intersections

in order to locate potential victims (Jacobs, 2000; St. Jean, 2007). Furthermore, when a crime occurs near an intersection, the police often write down the location as the intersection of two streets, e.g. Broad St. & Market St., rather than assigning an approximate address nearby (Braga et al., 2011, 2011; Braga et al., 2010).

Supporting Theories

Crime concentration at places can be projected mainly through routine activity theory, the rational choice perspective, and the crime pattern approach. Traditionally, criminological theories have examined individuals, and they have focused on why certain people commit crime and not others. Those theories mostly examined crime at a macro-level, such as studying why specific neighborhoods are crime-ridden and not others. When considering why certain intersections are more likely to facilitate dealing activities, traditional theories explaining crime as a whole are not enough to address this specific question. Most traditional criminological theories focused on identifying what motivates people to commit crime, such as biological deficiency, criminal labeling of juveniles, events in the early course of life, psychological trauma, etc., but these explanations ignored the immediate setting and how it influences and interacts with individuals.

This dissertation takes a different approach by examining three theoretical perspectives suggesting the importance of crime places – rational choice, routine activities, and crime pattern. These complementary theories, often called environmental criminology or opportunity theories, emphasize the understanding of criminal events at the local level, and support the research on place of crime concentration. Routine activity theory addresses the chemistry of the offense, individuals, time, place, and opportunities that develop. Rational choice theory focuses on the decision-making and viewpoint of the

offender, as to why the offender would rather commit crime, why the offender commits crime at the selected time and location, how the offender interacts with the environment and the opportunity, and what traits the place possesses to facilitate crimes. Crime pattern theory constructs patterns of criminal activity, and the crime opportunities generated according to those patterns. These theories provide a foundation for understanding why an environment is more criminogenic than others, and what are the environmental characteristics that facilitate crimes. Despite many dominant criminological theories that attempt to explain crime, these environmental theories are most suited to explain the nature and dynamic of drug dealing locations. This theoretical trend focuses on the immediate interaction of the place and the criminal opportunities intrinsic to it, rather than examining the history of the individuals or the background of their behavior.

1. Routine Activity Theory

"The whole is more than the sum of its parts. In a school science class, you may have mixed baking soda, vinegar, and dish detergent, producing a small eruption. Mixes make surprises for crime, too, for people mix in different ways" (Felson & Boba, 2009; p.25). The routine activity approach indicates that there are almost always three elements required for predatory crimes to happen: a likely offender, a suitable target, and the absence of a capable guardian against crime. The convergence of these three elements is often referred to as the "chemistry for crime." It is similar to the elements necessary for combustion: fire cannot exist without the combination of fuel, oxygen, and a heat source above the ignition temperature. The target may be an individual or an object in an offense; crime would not occur without a suitable target. The offender is the critical tipping point for a crime to occur, and anyone is a possible offender. A crime will takes place when

there exists a suitable target and a likely offender, and the two converge in time and place when a capable guardian is absent.

The routine activity theory began with a publication by Lawrence Cohen and Marcus Felson in 1979, which attempted to explain the changes to social structure and the escalating crime rate during the period from 1947 to 1974 in the U.S. Cohen and Felson viewed the crime rate trend as a byproduct of changes in variables such as women's participation in the labor force, single-adult households, and the increased portability of televisions and other valuable goods (Cohen & Felson, 1979). Cohen and Felson (1979) asserted that most criminal acts require the convergence in space and time of the three elements, and that the changes in the modern social structure produce this convergence in people's everyday activities.

The criminologist John Eck later supplemented the routine activity approach. He introduced the concept of "place manager" (Eck, 1994) into the chemistry for crime, and devised a "problem analysis triangle", which is shown as the inner triangle in Figure 9. A place manager may be anyone who has some responsibility for a place – store clerk, school teacher, bar owner, etc. The place manager also controls the behaviors of place users (Clarke & Eck, 2003; Sherman, 1995; p.38-39). The notion of place was re-emphasized in the chemistry for crime. Unless the motivated offender meets the target at the same place and time, no crime can occur. Like the example mentioned previously, places are analogous to oxygen: unless heat and fuel are brought together with oxygen present, there will be no fire. The latest formulation of the crime triangle adds the outer triangle of three kinds of "controllers" for each of the elements. While the inner triangle depicts the elements necessary to ignite a crime, the augment of handler indicates anyone

who can exert some control over the offender's actions, which may be parents, friends, or anyone who knows the offender well.

Figure 9 The Problem Analysis Triangle

Note. Source: www.popcenter.org

In later revisions of the routine activity approach, Felson emphasizes the importance of *setting* to crime. He addresses that, just as economists study markets, crime researchers can use *settings* (Felson & Boba, 2009). A setting is a location for "recurrent behavior at known times" (Felson, 2006); a crime setting is where individuals converge and diverge – affecting their crime opportunities (Felson, 2002). For example, an abandoned building offers a suitable place for drug transactions, while a busy street makes it more difficult. *Setting* is the central organizing feature of crime and its absence (Felson, 2002:21). Settings can help to conceptualize a "very physical process such as crime" (Felson, 2002). Illegal markets for drug trade or sex services, for example, have physical requirements and particularly depend on suitable settings. Among the different types of setting in daily life, some generate a lot more crimes than others (Clarke & Eck,

2007; Felson, 1987). The riskiest types of settings are:

1. Public routes - especially foot paths, parking lots, or unsupervised transit areas
2. Recreational settings – especially bars and public parks
3. Public transport – such as train stations and bus stops
4. Retail stores – such as convenience stores that involves cash transactions
5. Residential settings – suitable targets for burglary
6. Educational settings – especially on the edges and corners of a large space
7. Offices – easy entrance for any stranger
8. Human services – especially hospitals with hectic environments
9. Industrial locations – such as warehouses with lots of electronic products

Similar to the rational choice perspective, the routine activity approach also avoids speculation about the offender's motivation; instead, this approach focuses upon the conditions favoring the occurrence of a criminal event (Clarke, 1997). This approach was written in its starkest form as a deliberate attempt to offer an alternative to vague theories about crime (Cohen & Felson, 1979; Felson & Cohen, 1980).

2. Rational Choice Perspective

"If you want to develop practical ways of preventing criminal activity, go for the obvious: pay less attention to theorizing about criminal motivation, and more attention to finding out about how crimes happen" (Cornish & Clarke, 2008, p. 21). The rational choice perspective, as developed by Derek Cornish and Ronald Clarke in the early 1980s, originated with the intention of establishing a theory for practice.

In contrast to viewing criminal's behaviors as the outcome of constant criminal

motivations, the rational choice perspective views the desires and motives of a criminal and potential criminals as similar to everyone else in the population. Drawn from modern economic principles, rational choice researchers believe that the pattern of an individual's behavior reflects the choices made according to free will, the rational decision-making process, and weighing the cost and benefit of the action. The motives and actions of offenders are in continual interaction with opportunities and constraints in their surrounding environment which produce, reinforce, and perhaps reduce criminal behaviors.

More recently conceptualized rational choice perspective consists of six core concepts (Cornish & Clarke, 2008, p.24):

1. Criminal behavior is *purposive* - People have needs; they take necessary action to achieve particular goals. This principle can be applied to crime. Crimes are purposive and deliberate actions, which benefit the offenders. The benefits of offending include fulfilling common human motives, such as excitement, admiration, sexual desire, revenge, control, material goods, etc. Money, in this view, becomes a powerful motive of offending.
2. Criminal behavior is *rational* - People's actions are rational; they try to select the best available means possible to achieve their needs and goals. As addressed by psychologist and economist Richard Herrnstein (1990), people's rational decision-making "comes close to serving as the fundamental principle of the behavioral sciences" (p. 356). Departing from the perfect rational choice model used in economic science, the rational choice perspective borrows the notion of limited (or bounded) rationality from Herbert Simon (1990) to explain offending. Offending is

inherently risky, and it is not possible to obtain sufficient relevant information; thus, criminal behaviors are the outcome of offender's bounded decision-making.

3. Criminal decision-making is *crime-specific* – offenders do not just commit any type of crime. They carry out specific crimes, each of which has its own particular purpose, motive, and benefit. Criminal acts vary in the nature of the risk, require different levels of effort, offer different levels of reward, and the places within which they take place require different kinds of planning.
4. Criminal choices fall into two broad groups: "*involvement*" decision and "*event*" decision. Event decision relates to the crime act itself and concentrates upon crime-commission, which should be distinguished from criminal involvement decision. Involvement decision relates to the offender's criminal career, which includes decisions about initial involvement, habituation and desistance.
5. There are *separate stages* of involvement – In each stage of involvement, there are different sets of variables affecting the offender's decisions. For example, decisions to continue or desist from offending are most powerfully influenced by the offender's success or failure in the commission of crimes.
6. Criminal events unfold in a sequence of stages and decisions – Decision-making processes are required in different stages of a crime event. There are different levels of resources and actions needed during each of its stages. For example, an offender needs to decide on locations for different stages of his crime plan, or an offender needs to make use of the local criminal knowledge network when examining different places for an opportunity to commit crime (Walsh, 1980).

The rational choice perspective has paid little attention to the nature and profile of

the offender, and has had little to say about the history of the individual before the commission of a crime. This perspective focuses on the present, the immediate moment of the crime commission. The rational choice perspective is a theory for practice. It provides sources of crime prevention, and it encourages one to think about the criminal act from an offender's point of view. Since action is a function of opportunity as well as motivation, the rational choice perspective focuses on the points where the offender has to interact with the environment in order to achieve the goal, and indicates that criminal acts can be altered through changes in the immediate features of the environment. The rational choice perspective emphasizes person-situation interaction, the immediate precursors of criminal action, and the role of situational factors in the environment throughout the crime commission.

3. Crime Pattern Theory

"Crimes are patterned; decisions to commit crimes are patterned; and the process of committing a crime is patterned" (Brantingham & Brantingham, 2008, p.78). Canadian criminologists Paul Brantingham and Patricia Brantingham developed the crime pattern theory, also named Environmental Criminology, in the early 1980s. The primary objective of the theory is to understand how and why crime occurs at particular locations and whether crime could be predicted (Brantingham & Brantingham, 1981).

Understanding crime requires models that can be used to explain the patterned non-uniformity and non-randomness that characterizes real crime events (Brantingham & Brantingham, 2008). The crime pattern theory proposed eight guiding rules that create an image of crime events (Brantingham & Brantingham, 2008):

1. Individual *crime template*: Individuals have decision-making patterns and behavioral

patterns. Offenders have crime patterns, and such regularization creates a guiding template.

2. Network of offenders: Offenders' crime templates may mutually influence each other within the same network.
3. Average or typical patterns of a place or an event can be seen as the summation of the crime patterns of various individuals.
4. When a triggering event emerges and a target is present, the offender will commit a crime. The offender's crime template changes or is reinforced in response to the success or failure of the offense.
5. Crimes often occur on major *pathways* or *nodes* of individuals' daily routines, where large numbers of potential offenders and targets are brought together. For example, transit stops (Brantingham & Brantingham, 1981). Crimes also often occur along the *edges*.
6. Offenders, like everyone else, have normal spatial-temporal behavioral patterns, and the locations of crimes they commit are often near their normal activity and *awareness space.*
7. When the activity locations of potential victim and potential offender overlap, and a triggering event presents, a crime may happen.
8. Crimes occur within the context ingrained in the urban form. *Crime generators* are unintentionally created by high flows of people overlapping at activity locations within the built urban form, and *crime attractors* are created for activities more inclined to trigger crimes.

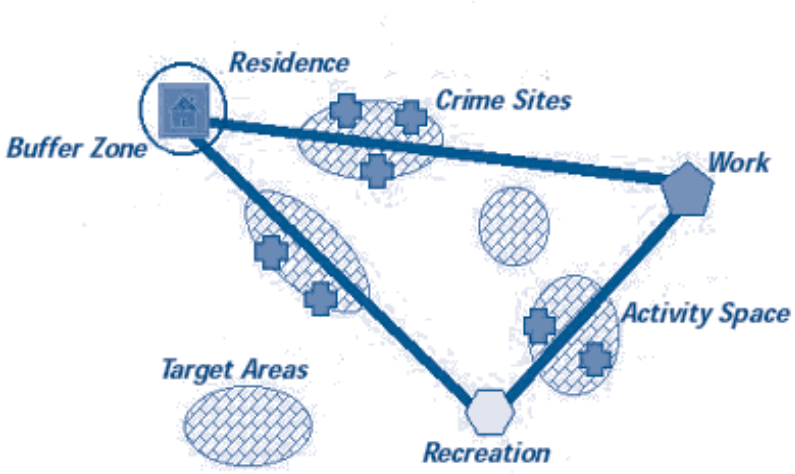

Figure 10 Brantingham Crime Pattern Theory

Note. Source: Rossmo (2000)

Brantingham and Brantingham (1995:8) view crime attractors as particular places or areas that create well-known criminal opportunities, attracting motivated offenders who are attracted to particular types of crime. Prostitution areas, drug markets, or bars are all crime attractors. Crime generators are viewed as nodal areas to which most people come for activities *unrelated* to criminal motivation. Shopping areas, transportation hubs, unsecured parking lots in business or commercial districts, and sporting events are common crime generators.

A major contribution of the crime pattern theory to contemporary studies of crime place is to encourage a focus on crime concentrations in *discrete* locations, as well as particular people, products and facilities (Clarke & Eck, 2005). The theory further demonstrates how environmental conditions - e.g., physical, cultural, economic, or temporal - and daily routines of potential victims and offenders affect the probability of hot spots emerging in particular places rather than others (Brantingham & Brantingham,

1999). Crime pattern theory addresses that crimes do not occur randomly, nor do they occur uniformly in time and space. There are hot spots and cold spots in a city, and there are repeat offenders and repeat victims. A very small percentage of the population commits most of the known crimes (Farrington, Lambert, & West, 1998; Wolfgang, 1991), and is responsible for a large proportion of the victimization statistics (Fattah, 1991). The formation of a crime hot spot is the result of interaction between a potential offender's motivation and characteristics of the surrounding environment (Brantingham & Brantingham, 1999).

It is essential to understand the structure of the environmental layout and how its elements contribute to the selection of target areas by offenders. Different property designs in different juxtapositions, arrayed in relation to different land uses on varying transport network will have different outcomes.

Summary of the Chapter

A crime is generated by the interactions of offenders and suitable targets in settings that make committing crime easy, safe, and profitable. The urban settings that generate crime are human constructions, which are built to support the functions of everyday life: housing, communities, shops, factories, public parks, recreational sites, transportation stops, arterial roads, and others. The establishment of these building blocks of daily activity in the urban environment has enormously impacted the types, frequency, and timing of the crimes that occur. This chapter examines the emergence of the importance of crime places in criminological research, and opportunity theories that support and foster this trend of research on crime. These theories offer a foundation facilitating the examinations of the situational factors in the next chapter. The next

chapter will examine relevant literature on the core situational characteristics that contribute to the transformation of a place into one suitable for drug dealing activities.

CHAPTER 4: THE ROLE OF SITUATIONAL FACTORS IN STREET DRUG DEALING

In the last chapter, several theoretical explanations addressed that place is critical to the occurrence of drug dealing. This chapter identifies relevant situational factors interrelated with environmental criminology; specifically the factors that have been found by prior studies to facilitate street drug dealing activity. It is suspected that some factors are taken into consideration by drug dealers when selecting a location for exchange. In this chapter, the review seeks to identify situational factors in the *immediate* environment that facilitate drug dealing activity.

Relevant situational factors are framed by three main theoretical concepts: guardianship (the routine activity theory), accessibility (the rational choice perspective), and crime generators (the crime pattern theory). These factors of interest facilitate drug dealing because they (1) provide or fail to provide capable guardianship, (2) allow easy access and escape for the dealer, or (3) generate crime opportunities attracting drug dealing to take place. The chapter concludes with a Table listing the relevant situational factors of interest. Research questions are then formed accordingly in the following chapter.

1. Guardianship Factors

Crimes are more likely to occur when a suitable target and a likely offender converge at a place where no capable guardian is present (Cohen & Felson, 1979). For example, robbery is more likely to occur when a lone victim is walking on an obscure street in the evening. Corners on campuses lack “place managers,” which enables bullying behaviors to happen. Pedestrian paths and small alleys may be obscure and

lacking natural surveillance, which invites drug dealing activities to take place (Myhre, 2000). Eck (1995) addressed the fact that a drug-dealing operation requires a relatively secure and concealed environment for the exchange to happen. Four situational factors are chosen and discussed as follows.

(1) Abandoned Buildings

An abandoned building indicates a building that is unoccupied and in disrepair, perhaps boarded up, covered with graffiti, and surrounded by garbage. A building possessing these traits is typically a hazard to the health and welfare of the community. A maintained building typically possesses informal surveillance from its tenants, or natural surveillance from the pedestrians who walk by; however, an abandoned building lacks such surveillance to guard the place. When a building is lacking a place manager, such as an owner or a tenant, drug dealers are more likely to establish a market around it because no one is managing the place or is exerting any control inside and around it (Eck, 1994). Once a building acquires a reputation for being a criminal environment, criminals are drawn to use the building more frequently, which deteriorates the building further and increases crime and disorderly conditions. Moreover, an abandoned building provides cover for likely criminals. They are easily drawn to and hide behind an abandoned property because it has few entry barriers and controls (Brantingham & Brantingham, 1995).

In a qualitative study in New York City, Curtis and Wendel (2000) used informants to gauge the extent of drugs found in the neighborhoods, and identified the dealers and users to be generally active around places such as abandoned buildings. It is because an abandoned building offers suitable (and concealed) space for drug dealers and

buyers to converge inside for activities. Rengert (1996) addressed the fact that an abandoned building provides additional security and concealment once the dealers and buyers are inside; drugs and cash may be passed through a gap in a broken door or window; it may also generate shaded corners to conceal drug trade activities. Spelman (1993) examined the relationship between abandoned buildings and criminal offenses around it, including thefts, drug dealing, prostitution, and others, in a low-income neighborhood in Austin, Texas. He compared street segments containing abandoned buildings to segments without abandoned buildings, and found that there were significantly more calls-for-services to the police regarding illegal activities occurring in and around abandoned buildings. Spelman's (1993) findings suggested that drug activities are likely to cluster in or near abandoned buildings because it is a convenient and safe "hang-out" location for dealers waiting for business. Weisburd and Green (1994) noted abandoned buildings to be a critical indicator for local drug markets. Yonas, O'Campo, Burke, and Gielen (2007) also found an association between vacant/dilapidated housing and urban youth violence problems, including local drug activity and guns.

(2) Vacant Land

The presence of unsupervised vacant land imposes great risks to the environment. Vacant land describes the lack of both informal and formal guardianship at a place. A place with vacant land has less human activity which can act as natural surveillance (less commercial activities or vehicular flows nearby), and such conditions decrease the number of 'eyes on the street' (Jacobs, 1961) and decrease the amount of informal surveillance and potential guardians.

Also, urban architects suggest that crimes are more likely to happen when residential areas are mixed with commercial uses or vacant land (Poyner, 1983). When vacant lots and commercial land uses were combined, they contributed significantly to street litter and vandalism (Evans & Oulds, 1984; Herbert, 1982). Duffala (1976) found that when a convenience store is located in a predominantly residential area filled with vacant land use, the store is more vulnerable to armed robbery.

Vacant land is also associated with local drug activities. Vacant land is sometimes an indicator of decline, often acting as receptacles for trash and debris. Because vacant land is often overgrown with unwanted vegetation and filled with garbage, they are potentially attractive places for activities such as illegal drug sales and use, and illegal gun storage (Spelman, 1993; Brownlow, 2006; Branas, Cheney, MacDonald, Tam, Jackson, & Ten Have, 2011; Furr-Holden, Lee, Milam, Johnson, Lee, & Ialongo, 2011). Myhre (2000) found that unclaimed open land correlates with drug market activities in and around public housing areas.

(3) Public Parks

Public parks play a key role in generating a location where edges and corners are unsupervised, and vulnerable to criminal activities. Parks are publicly owned, and, as public resources, they have little intrinsic guardianship and are vulnerable to undesirable activities, such as homelessness and drug dealing (Groff & McCord, 2012). Parks are also nodal points where people, such as parents with kids or teenagers with skateboards, converge at given times (after work or school) to use the space and facilities. These place users often interact with each other and are potential customers, which attracts dealers to come to spread information about the drug sale business throughout the network.

Rengert (1996) suspected that drug dealers might travel to local parks to sell drugs to students during the school days. Discarded drug paraphernalia or syringes are often found inside parks (Green, 1996; Lupton et al., 2002; Mazerolle, et al., 2004). Its large space and unguarded corners and edges provide suitable places for drug dealing, and make public parks an ideal location for drug activities.

(4) Churches

Research on the relationship between churches and local crime is limited, and often focuses on disadvantaged Black American neighborhoods. Research on churches mainly focuses on how churches deliver religious beliefs to the individuals and may affect their criminal tendencies (Johnson, Jang, Li, & Larson 2000), or how churches function as informal social controls among the neighborhood residents and thereby hinder crime (Rose & Clear, 2006).

It is suspected that people who interact with churches are guided by their religious beliefs, and people who seek out churches for religious support would not actively seek out opportunities to commit crime around the churches (Taylor, Thornton & Chatters, 1987). A small body of empirical studies has shown that there is a negative relationship between the presence of churches and violent crime in rural counties (Lee, 2008; 2010). Stockdale and her colleagues (2007) found that churches per capita is associated with a lower likelihood of drug use disorder among the neighborhood residents.

2. Accessibility Factors

For legal retail businesses, market geography literature has addressed the importance of spatial location. Ghosh and McLafferty (1987) once stated that:

> A well-designed location strategy is an integral and important part of corporate strategy for retail firms. Whether selling goods or services, the choice of outlet locations is perhaps the most important decision a retailer has to make. It is through the location that goods and services are made available to potential customers. Good locations allow ready access, attract large numbers of customers, and increase the potential sales of retail outlets.

Similar to this economic principle, research on crime place has demonstrated that areas suffering from a high frequency of crime are often the areas that are easily accessible to offenders via transportation hubs, such as major arterial roads, subways systems, and bus lines (Brantingham & Brantingham, 1991). In particular, studies have applied this marketing perspective to evaluate illegal drug businesses and its role in drug dealers' decision to choose certain locations. Various studies have examined the linkage between accessibility and the occurrence of street drug dealing. Drug dealers often choose a location that allows easy access for the customers, and offers them various avenues of escape (Harocopos & Hough, 2005; Jacobson, 1999; Knutsson, 1997; Conner & Burns, 1991; Edmunds, et al., 1996; Rengert, et al., 2000; Myhre, 2000; McCord & Ratcliffe, 2007; Rengert, Chakravorty, Bole, & Henderson, 2000; and Rengert et al., 2005). In addition, Rengert et al. (2005) addressed the idea that easy access is a strongly significant predictor for whether or not an illegal drug market can be sustained at the location. For the dealer, a suitable location has to be accessible to public transportation or an arterial route, so that even if local buyers decrease, the dealer can still maintain enough profit to sustain the drug business without having to recruit more buyers or expand the geographical range of the market (Rengert et al., 2005)

(1) Bus Stops

There have existed a number of studies examining transit crimes, though most of

them focus on why crime is clustered in and around train and subway stations (LaVigne, 1997; Poister, 1996; Levy, 1994; Scnell, Smith, Dimsdale, & Thrasher, 1973; Block and Davis, 1996; and Loukaitou-Sideris, Liggett, & Iseki, 2002). Police data have indicated that the majority of reported transit crimes were committed in buses and around bus stops (Loukaitou-Sideris, 1999; Levine & Wachs, 1986). High crime around bus stops may be due to the type of commercial establishments nearby (Block & Block, 2000; Liggett, Loukaitou-Sideris, & Iseki, 2001; Yu, 2009). A recent analysis of bus stops and neighborhood-level crimes in Newark showed that increases in the number of bus stops and bus routes are associated with increased crime in the neighborhoods, which is due to the increased criminal opportunity in the area (Yu, 2009).

Poorly-maintained bus shelters emanate an air of desolation (Loukaitou-Sideris, 2002); they offer open spaces for loitering, panhandling, vandalism, homelessness, and drug dealing and using; the often intense pedestrian activity offers natural crowding that masks dealing activities; and they allow drug dealers to escape the place easily (Loukaitou-Sideris, 1999). Major public transportation interchanges, such as train or subway stations and bus stops which offer easy access are likely to attract illegal drug dealers because it makes it convenient for outside buyers to enter the dealing location, which brings in business (Rengert et al., 2005; Edmunds et al., 1996; Block & Block, 1995). Eck (1994) discovered that in San Diego, CA, street drug markets formed at locations within two blocks of major transportation arteries. Similarly, McCord and Ratcliffe (2007) suggested that drug markets may prosper from being close to certain facilities within the neighborhood that bring in buyers, including particular activity nodes such as subway stations.

(2) Highways

The street network is considered one of the most important components of the accessibility to a local street drug market (Weisburd et al., 2012). It contains major local roads, interstate highways, and other roads that extend in various directions. An interstate highway, in particular, easily funnels drug buyers into a local drug market from all directions, and turning around to retreat easily after the drug exchange is completed (Rengert et al., 2005)

In a study examining drug activity in and around public housings in Washington, D.C., Myhre (2000) addressed a few situational precipitators that reduce the effort as well as lower the risk for dealers: places that are near highways (and near major arterial roads) offer easy access and escape for the dealers, lower their efforts in completing transactions, and thus attract increased drug dealing activity (Myhre, 2000).

Highways provide advantages and easy accessibility for drug dealers and buyers via vehicular traffic; however, it should be noted that drug dealing activity mostly involves at least two individuals to meet and interact. Highways contain only high-speed vehicular traffic, and the road shoulders are open and visible to everyone. Therefore, the highway itself is highly improbable to provide a suitable and comfortable location for a drug exchange to take place. Instead, this dissertation focuses on the distance from the highway exits as the factor for analysis (Rengert et al., 2005). For example, in a study in Wilmington, DE, Rengert and his colleagues (2005) demonstrated that a 1,200 – 1,600 foot zone (or the three- to four-block radius) of a highway exit is where drug dealing activities are most concentrated.

3. Crime Generator Factors

> Crime generators are places to which large numbers of people are attracted for reasons unrelated to criminal motivation. Providing large numbers of opportunities for offenders and targets to come together in time and place produces crime or disorder.
>
> Crime Attractors are places affording many criminal opportunities that are well known to offenders. People with criminal motivation are drawn to such locales. In the short run, offenders may come from outside the area, but over longer time periods, and under some circumstances, offenders may relocate to these areas. (Cited from Clarke and Eck, 2005, *Crime Analysis for Problem Solvers in 60 Small Steps*)

Eck (1995) suggested that drug dealers locate suitable dealing locations via their daily activity routes. These locations are often near their activity nodes such as work, home, or shopping centers (Brantingham & Brantingham, 1995). The potential dealers are familiar with the setting of these locations, so they are more comfortable committing drug transactions in such locations. Edmunds and his colleagues (1996) suggested that the spatial distribution of street dealing activity is a reflection of the environment infrastructure that facilitates dealing. According to Edmunds and his colleagues, the environment often includes physical features that offer avenues for avoiding the police. The environment may include features that are used as “lookout points” or “hanging-out places” for the dealer to wait for the next customer. Fencing gaps and exterior handles may also offer hangout spot for the drug dealers when they are waiting for transactions (Myhre, 2000). Additionally, the environment may contain legitimate street activity to disguise the dealing conduct, as well as offer opportunities for raising additional money in other ways. The dealers may use a public payphone or mailbox as a drop-off spot when a transaction is scheduled. The environment may include a higher availability of drug-using equipment, such as syringes from a pharmacy.

(1) Parking Lot

Parking lots are a setting with a lot of transient strangers, the convergence of potential victims and motivated offenders generate a higher chance of crime. Examples like large, unsecured parking lots in commercial or business plazas, and "park and ride" parking lots can generate crime because of the volumes of strangers that pass through them, and no place-managers are actively regulating the activities inside the lots[2].

Unsecured parking lots signal poor management and offer criminal opportunities, which attract unwelcome activities, such as robbery, assault, and auto theft (Laycock & Austin, 1992). Auto theft is more likely to occur if the parking lot is unguarded and there is no visible anti-theft device attached to the vehicle. Previous research has shown that at the street block level, parking lots were significantly related to increased auto theft (Taylor et al., 1995). Parking lots (when combined with vacant land) were also significantly related to street robbery (Kurtz et al., 1998). It was found by multiple studies that auto theft and theft from cars are concentrated in and around parking lots where people feel their cars are safe (Poyner, 1992; Eck and Spellman, 1994; Fleming et al., 1994). In a study of car break-ins and thefts in downtown parking facilities in Charlotte, North Carolina, Clarke and Goldstein (2003) found that the number of offenses in these parking facilities was not merely a result of size; rather, it was found that some smaller facilities experienced large numbers of thefts because of security deficiencies.

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[2] A recent newspaper article reported that the police arrested two individuals allegedly transacting a drug deal in a parking lot of the Worcester Police Department in October 2013 in Massachusetts. http://www.boston.com/news/local/massachusetts/2013/10/31/drug-deal-done-police-parking-lot-authorities-say/43w46NdexNNjmAxejxCLfN/story.html

Another recent newspaper article reported that a group of teens were arrested after a drug deal gone bad that deteriorated into a fight in a parking lot of a Target department store in December 2013 in New Jersey. http://gloucestertownship.patch.com/groups/police-and-fire/p/drug-deal-gone-bad-leads-to-fight-in-target-parking-lot-police-say

An unsecured parking lot is also a risky facility that generates great opportunities for crime like drug sales (Brantingham & Brantingham, 1995). An open, unsecured parking lot is often a space in suburban areas in which teenagers hang out and chat and share information. Rengert (1996) suspected that drug dealers may travel to a parking lot to sell drugs to the music fans waiting in line before a music festival or concert begins. Sussman and colleagues (1998) found in their self-report study that high-school youths often use drugs in restrooms or parking lots on campus.

(2) Retail Business-Related Facility

Previous studies have addressed a wide range of legal businesses that have great potential to become crime generators. Numerous studies have confirmed a positive relationship between commercial areas and crime (Beavon, Brantingham, & Brantingham, 1994; Crewe, 2001; Kurtz, Koons, & Taylor, 1998; Perkins, Wandersman, Rich, & Taylor, 1993; Taylor, Koons, Kurtz, Greene, & Perkins, 1995). The relationships between local drug markets and retail stores such as bookstores, convenience stores, retail clothing stores, sporting goods stores, supermarkets, automobile repair shops, etc. were examined in Eck's (1994) work. Further, Ford and Beveridge (2004) explored the link between visible drug sales and the local legal businesses in these neighborhoods. They concluded that visible drug activities decrease the collective efficacy of these neighborhoods and discourage legal businesses from coming into these neighborhoods. This, in turn, further deteriorates the neighborhood and attracts more illegal drug activity to the neighborhood. This section will only discuss a few types of retail store that have been more commonly discussed in the crime literature.

Bars are places that attract crimes, and are intrinsically risky settings. People

converge in this type of confined space, and are mostly influenced by alcohol. Alcohol is a type of chemical facilitator (Clarke & Eck, 2005) that increases potential offenders' abilities to ignore risks and prohibitions. Some likely offenders drink heavily before a crime in order to decrease their nervousness. A study in Northern Cape, South Africa (Louw & Shaw, 1997) reveals that alcohol consumption is a strong indicator of a high rate of violence. A number of studies have shown that neighborhoods surrounding alcohol sales outlets, taverns, and liquor stores suffer higher crime levels (Roncek & Maier, 1991; Roncek & Pravatiner, 1989). Rengert, Ratcliffe, and Chakravorty (2005) found that the tavern is a constantly significant indicator of drug market activity and a crime generator. Sherman, Gartin, and Buerger (1989) found that liquor outlets are closely associated with 'hot spots' of crime. Bar-goers may buy recreational drugs in order to enhance their partying experiences. Acknowledging the monetary incentive, drug dealers are likely to be attracted to seek for potential buyers in and around these local bars and nightclubs (Rengert, 1996). Studies have found that drug users frequently combine alcohol and drug use and many suffer from concurrent addictions (for example, Best, Rawaf, Rowley, Floyd, Manning, & Strang, 2000; Wadsworth, Moss, Simpson, & Smith, 2004). Dealers are likely to run their businesses in areas full of alcohol outlets for the profit. Drug markets benefit from being located near alcohol outlets. In addition, Jacobson (1999) argued that bars and restaurants provide legitimate use of certain equipment, such as water, citric acid or lemons, foil, and ashtrays, and are therefore likely to interactively facilitate drug-dealing activities. Take-out fast food stores, such as Chinese takeout or fried chicken, may be suspicious for local drug activities. Discarded drug paraphernalia or used syringes are often found next to these types of food establishments (Green, 1996;

Lupton et al., 2002; Mazerolle, et al., 2004).

Cash-involved stores, for example, are at-risk facilities that breed drug-dealing activities. In a study in the UK, a location containing cash-involved facilities such as a bank or cashing-point store where checks can be cashed were found to attract more drug activity (Jacobson, 1999). McCord and Ratcliffe (2007) noted that drug addicts need cash to buy drugs. Accordingly, drug markets may profit from being close to cash-providing businesses such as pawnshops and check-cashing stores. Rengert and his colleagues (2005) found that check-cashing stores, liquor stores and pawnshops are strongly significant predictors for whether or not an illegal drug markets can be sustained in a given area.

The pawnshop, for example, is a business that offers secured loans to people who pledge some personal belongings as security. Pawnshops are often associated with people having financial problems. People often steal property in order to exchange it for fast cash from pawnshops. Markets for stolen goods act as incentives for thieves to steal. Pawnshops breed crime because they are often the outlets for stolen property (Fass & Francis, 2004). Pawnshops are often located in communities with higher crime, and serve the monetary needs of low-income individuals. The presence of pawnshops may stimulate crime in a neighborhood; an increase in the number of pawnshops is often associated with an increase in crimes in which pawnable property is stolen (Miles, 2000). Drug users use pawnshops to obtain fast cash to buy drugs. Ferrante and Clare (2007) addressed that thieves and burglars frequently dispose of the stolen goods through friends, drug dealers, pawnshops, and other legitimate commercial stores dealing in second-hand goods. They further found that many drug dealers accept non-cash items in exchange for

drugs. There is a correlation between drug-dealing activity, property crime, and pawnshops in an area.

The barbershop, for example, is designed to provide quick hair-cutting services to their customers. It is a place where transient place users frequent. During the time customers are waiting for or receiving the service, such places offer opportunities for customers to chat and exchange information. Wood and Brunson (2007) assessed the specifics of the built landscape of the neighborhood in which the barbershops are located, and found that African-American barbershops are important community institutions that provide excessive benefits that are far beyond the provision of haircutting services. A study by Wright and Calhoun (2001) found that urban African-American barbershops have the potential to be a place that provides criminal opportunities for any number of illegal activities to take place. This type of store also acts as a hangout where individuals can renew and sustain social networks within the community (Wright & Calhoun, 2001). The barbershop is often a destination for "ghetto entrepreneurs" (Anderson, 1976), where individuals engage in legal and illegal activities in an underground economy. Drug dealing activity may operate in and around such settings.

Summary of the Chapter

This chapter reviews the key situational factors that are commonly studied in the crime literature. These factors have been discussed in a number of different theories, but in this dissertation they are sorted by their most-commonly applied theoretical explanations. These factors are organized here in the Table 1 so as to prepare for the GSV data collection in the later chapters. Table 1 below summarizes the key situational factors

that have been indicated to affect the development of local street drug markets[3]. Table 1 includes the key factors discussed in the literature, and additional factors observed during the field observations in Newark or suggested by officers' experiences (see Chapter 2). These factors are grouped in relation to their theoretical explanations. The Table presents the information in six columns: The first column indicates the name of the situational factor; the second column indicates the key references cited in this dissertation; the third column indicates whether the factor is suggested by the experienced Newark officers or observed during the field observations by the author; the fourth column indicates whether the factor can be captured on Google Street Views or not; the fifth column indicates whether or not the factor is kept for the further analysis; and the sixth column indicates the theoretical explanation for the factor. In sum, these are the situational factors that will be employed for further statistical analysis.

[3] The Table lists eight factors frequently discussed in the past literature and five factors identified during the field observations in Newark. Originally, the review of literature identified more than 50 situational characteristics of street drug-dealing activity. However, because (1) some characteristics are rarely mentioned in the literature (for example, "video store" in Eck, 1994), (2) some characteristics do not exist in Newark (for example, "shooting gallery" in Curtis and Wendel, 2000), and (3) some characteristics are not *temporally-stable* situational factors (for example, "chairs used by dealers" in Myhre, 2000), only a portion of the characteristics are selected for inclusion in the summary Table listed below. For example, some factors are commonly addressed in the previous literature but are excluded due to the considerations below:

- Abandoned vehicles: It is almost impossible to determine whether the parked vehicles shown on Google Street View are "abandoned" or not. The parked vehicles may be classified into "abandoned vehicles" only if the image displays a missing tire, missing steering wheels, and the like. School: many school campuses range larger than a block of street. Street lighting: The GSV feature contains street images taken during the daytime, and offers no night view of places. It is mostly impossible to determine if a location has bright lighting or poor lighting based on GSV images. Unofficial trash receptacle: It is not a temporally-stable situational factor because it may be removed during the street cleaning service, and the GSV image does not capture the changes.

Table 2 *Summary of the Key Situational Factors of Interest*

Situational Factor	**Key References**	**Gathered During Field Audits**	**Has GSV Image**	**Kept for Further Analysis**	**Function (Theoretical Explanation)**
Abandoned Building	Conner & Burns (1991) Weisburd & Green (1994) Curtis & Wendel (2000) Myhre (2000) Spelman (1993)		Yes	Yes	Guardianship (Routine Activity Theory)
Public Park	Conner & Burns (1991) Groff & McCord (2012) Jacobs (1961) Eck (1994) Rengert (1996) Harocopos & Hough (2005) Knutsson (1997) Knutsson (2000)		Yes	Yes	
Vacant land	Myhre (2000) Curtis & Wendel (2000)	Yes	Yes	Yes	
Church	Johnson et al. (2000) Rose & Clear (2006) Taylor et al. (1987) Lee, 2008; 2010 Stockdale et al. (2007)		Yes	Yes	
Bus Stop	Eck (1994) Hales & Hobbs (2009) Harocopos & Hough (2005) Lupton et al. (2002) McCord & Ratcliffe (2007) Rengert, et al. (2005) Robinson & Rengert (2006) Loukaitou-Sideris (1999, 2002)		Yes	Yes	Accessibility (Rational Choice Theory)
Highway	Conner & Burns (1991) Eck (1994, 1995) Green (1996) Hales & Hobbs (2009) Harocopos & Hough (2005) McCord & Ratcliffe (2007) Rengert et al. (2000) Rengert et al. (2005)	Yes	Yes	Yes	
Parking Lot	Brantingham & Brantingham (1995) Rengert (1996) Jacobson (1999) Weisburd & Green (1994) Myhre (2000)	Yes	Yes	Yes	Crime Generator and Attractor (Crime Pattern Theory)

Retail Facility	Conner & Burns (1991) Curtis & Wendel (2000) Eck (1994) Edmunds et al. (1996) Banerjee et al. (2008) Green (1996) Hales & Hobbs (2009) Jacobson (1999) Knutsson (1997) Myhre (2000) Mazerolle, et al. (2004) McCord & Ratcliffe (2007) Rengert (1996) Rengert, et al. (2000) Rengert, et al. (2005) Ford & Beveridge (2004) Lupton et al. (2002) Spillane (1998) Weisburd & Green (1994)	Yes	Yes	Yes	
Retaining Wall	Eck (1994) Conner & Burns (1991) Myhre (2000)	Yes	Yes	Yes	Hangout Spot (From the Field Observations)
Apartment Stoops		Yes	Yes	Yes	
Cemetery		Yes	Yes	Yes	Drop-off Point (From the Field Observations)
Pay Phones	Eck (1994) Harocopos & Hough (2005) Jacobson (1999) Myhre (2000) Lupton et al. (2002)		Yes	Yes	
Mailbox	Myhre (2000)	Yes	Yes	Yes	

CHAPTER 5: SITUATIONAL MODEL OF STREET DRUG DEALING AND HYPOTHESES

This study tries to rationalize drug-dealing events through understanding dealing locations and how they may alter the decisions of individuals who commit drug crimes. This chapter seeks to formulate some hypotheses in regards to the above issue. Some suspect that the locations containing specific features make drug transactions easier for dealers to commit; the environmental design offers privacy that favors drug dealers' illegal conduct; and so on. This chapter begins with a proposed situational model of street drug-dealing activity, linking relationships between the individuals and their immediate surrounding. This chapter then describes the research questions addressed by this dissertation and the corresponding hypotheses established to examine these questions.

The Proposed Model

Supported particularly by the rational choice perspective, a crime event is mostly the outcome of a criminal's choice. One may argue that a drug transaction is the result of the drug user's addiction; however, this line of thought requires understanding the medical model behind addiction and rigorous scientific treatment services for the addicts, rather than law enforcement actions or the punishment of dealers. Both the review of relevant literature and field observations support the notion that those known dealing locations possess certain physical features favorable to dealing activities, which the dealers then exploit to conduct drug transactions. As a result, dealing activities are clustered at a few locations with this quality. The fact that some locations have significantly more dealing activity while others do not implies that dealers choose to take advantage of the opportunities in one location rather than another.

In *The Works of Mencius* (B.C. 372-289, translated by Legge, 1895), there is a proverb: “To establish the right conditions for an action (‘war’ in the original context) to take place, good timing is not as desirable as the convergence of a favorable location and the right individuals” (天時不如地利，地利不如人和。《孟子·公孫醜下》). The review of relevant literature in Chapter 3 and 4 echoes the above statement: Good timing is a desirable feature, but the location and individuals have the most important causal roles in the action. Street drug markets may be studied in terms of three aspects: the place, dealer, and situational factors that connect them; this dissertation attempts to establish a structure for explaining the dynamic of street drug markets in these terms. Drawn from the Opportunity Structure for Crime developed by Clarke (1995) and the Crime Triangle by Eck (1994), a model for the dynamic governing the street drug market is proposed to illustrate how an opportunity for dealing activity becomes manifest (see Figure 11).

Drug-dealing activities tend to concentrate at specific places, and leave other places free (Eck, 1995). It is likely that this variation in outcomes is the result of differences in key factors, such as a bus stop or tavern. Alternatively, it is also likely that there may not be a difference in the factors involved so much as in how the factors interact with one another. Situational contributors may be better understood when considered in the full context of surrounding factors (Taylor, 2007). It may be the combination of factors that facilitates the growth of a local drug market, rather than a single attribute. Thus, the proposed model intends to demonstrate the interrelationships among these factors, place, and individuals.

Each element in the model is interrelated to conceptualize the relationship between the factors and the environment. The conceptualization of the “event process”

(Taylor, 2007) is thus incorporated in the development of the model. An event process refers to the examination of situational features as they operate within the stream of the entire event (Taylor, 2007). The conduct of drug dealing is an event process containing many small steps towards the outcome. A drug-dealing event may begin with a motivated individual, who is encouraged by a peer one day, and the individual takes the first step: for example, approaching a friend for potential work opportunities. Once he possesses the product, he releases the information to his acquaintances, and then he waits for inquiries. When the potential customer appears, he initiates communication and sets up the deal. After the drug deal is arranged between himself and the buyer, he then proceeds to the drop-off location to exchange the drugs for money. As suggested by Taylor (2007), the evolvement of the outcome (a dealing action) might proceed differently if the individual views the situational opportunity differently. Accordingly, this structure starts out with an explicit focus on the creation of the event outcome (a dealing action) that illustrates the event process in the progression of interactions among the individual, place, and environmental factors.

Based on Figure 11 below, three factors are the “almost-always elements” (Felson & Boba, 2009) present for a drug-dealing opportunity to occur: the dealer, place and customer. The center square represents the “place,” suggesting that, even with the convergence of the dealer and the customer, a suitable place is a necessary element in generating the opportunity for a drug deal. To act as a suitable place, three main features are critical: 1. lack of a capable guardian, 2. accessibility, and 3. crime generators.

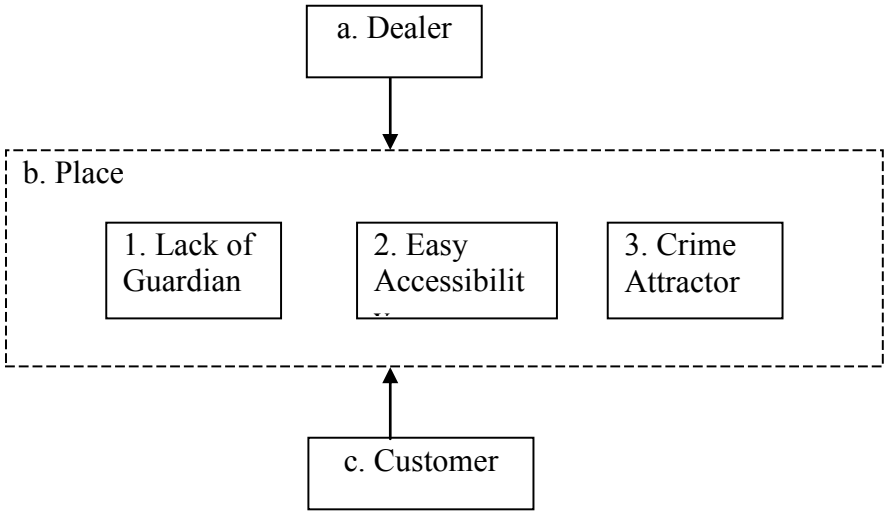


Figure 11 Situational model of drug dealing

The first main feature represents the critical role of guardianship. When a dealer sees an opportunity in the environment, has a car for use, and is not controlled by a guardian figure, he or she is more likely to take advantage of the opportunity to deal drugs. The second feature represents the role of easy accessibility. For example, the presence of an accessible highway in the physical environment can be a feature attracting dealers to choose such a place for dealing. The third main feature represents the role of the crime generator. For example, when a place has fully urbanized into a metropolitan area, is filled with bars and night clubs (crime generators), and covered with graffiti and litter (lack of place manager), this place is more likely to appear to be an untended location offering drug-dealing opportunities.

Hypotheses

This dissertation, thus, seeks to address the following four hypotheses. These hypotheses are divided into two categories: to test environmental criminological theories, and to test the analytical units – the segment and intersection. Under the first category,

the first three hypotheses generally evaluate the characteristics associated with the location where drug-dealing activity is frequently present. These hypotheses assume there are situational factors attracting dealers to the areas for drug transactions: for example, situational features concealing the dealer's illegal activities, retail business-related features that keep dealers occupied when not currently dealing, or features offering a hangout spot for dealers while waiting for potential customers to show up. Under the second category, the fourth hypothesis asks whether segments with a high concentration of dealing activity have the same risk factors as the factors on intersections with a similar concentration. The operating hypotheses are proposed as follows.

Hypothesis 1: Street drug dealing happens at locations lacking capable guardians.

Street drug dealing happens at locations surrounded by situational characteristics that offer crime opportunities favorable for dealers' business and security. These places lack formal or informal guardianship, in which the police or potential place manager pose less threat, thus providing natural locations for drug dealers to setup business. Thus, it is hypothesized that a location is associated with more drug-dealing activity if vacant land, public recreational facilities, an unattended parking lot, or open unattended cemetery are present.

Hypothesis 2: Street drug dealing happens at locations connecting with an easy in-and-out entrance or escape route.

Street drug dealing happens at locations surrounded by situational characteristics that allow easy access and escape, thus shortening the drug dealers' time spent entering and exiting the area, and decreasing their chances of being apprehended by the police. For example, a drug dealer in a car may drive into the area, drop off the drug products to the buyer, and make an immediate turn to get on the interstate highway. Or, a drug dealer

on foot may meet up with the buyer at an intersection, exchange the products and money, and run into a small alley into which police vehicles cannot enter. Thus, it is hypothesized that a location is associated with more drug-dealing activity if a bus shelter, highway, or small alley inaccessible to police vehicles is present.

Hypothesis 3: Street drug dealing happens at locations that generate opportunities for drug activity.

Street drug dealing happens at locations surrounded by situational characteristics that offer hangout spots or other legal income-making opportunities for dealers when they are waiting for the next transaction. Places possessing these characteristics unintentionally generate unrelated crimes or attract more crimes to take place. For example, the front stoops of buildings become ideal hangout locations, thus unintentionally inviting drug dealers to sit and wait for the next deal; a public payphone serves as an easy-access depository space that allows drug dealers to temporarily store drug products in case the police do body searches; and retail stores are frequently involved in high cash flow exchanges, which can be a front for illegal activities. Thus, it is hypothesized that a location is associated with more drug-dealing activity if a barbershop, pawnshop, payphone, or mailbox is present, or if stoops in front of a multi-unit building or retaining walls around a multi-family housing complex are present. It is also hypothesized that a location is associated with more drug dealing activity if the number of retail stores, take-out restaurants, bars and other alcohol establishments increases.

Hypothesis 4: Drug-dealing street segments are distinguishable from drug-dealing intersections. There is a separate set of situational risk characteristics for street segments than for intersections.

Crime opportunities presented on street segments that facilitate drug dealing to

happen are distinguishable from the opportunities on intersections. For example, an intersection connecting with an obscure alleyway inaccessible to police vehicles offers drug dealers on foot an easy retreat route, because the dealer can easily enter and be protected by the natural barrier; thus the presence of small alleyways is a unique situational characteristic particularly relevant at intersections rather than on street segments. Or, a liquor store at an intersection may have more customers buying alcoholic beverages, and thus drug dealers are more likely to come here looking for potential drug buyers rather than going to a store on a residential street block. Therefore, it is hypothesized that these situational factors have different impacts on street segments as opposed to intersections.

Summary of the Chapter

Prior research on crime hot spots indicates that crimes are not independently distributed, but rather concentrated at specific places (Eck, 1995). Crimes are not evenly distributed; street drug markets are no different. This dissertation examines drug-dealing behaviors through the eyes of drug dealers, and tries to discover the factors that make an individual exploit the opportunities to commit dealing behavior. This chapter tries to develop a situational model for explaining street drug-dealing activity, capturing factors that are identified in the literature. Three hypotheses regarding each main element in the process of a dealing event are proposed, and a fourth hypothesis is proposed to test the possible variation in the two geographic units of interest. The next chapter discusses the research design applied to incorporate the elements in this structure and test these hypotheses. The data and variables selected are also discussed in the next chapter.

CHAPTER 6: RESEARCH METHOD

This chapter describes the structure of the study method designed to explore the drug market problem in Newark, NJ. Beginning with the standard case-control design, the chapter explains the reasons behind using a matched case-control design. The chapter then discusses the units of analysis, data collections, sampling procedure, and, lastly, the key variables examined. Specifically, this chapter illustrates the selection criterion performed to identify active drug markets in Newark as the cases. The chapter considers locations free of drug dealing to be the controls, and matches the selected dealing-free locations with case locations based on confounding factors. Subsequently, this chapter explains the plan to implement Google Street View in selected locations in Newark, and explore the data reliability of using Google Street View as an alternative for collecting field observation data.

A Matched Case-Control Study

This dissertation uses a matched case-control design to examine the hypotheses. The main goal of this dissertation is to identify situational features ingrained in the immediate environment of a place that increases its possibility of being used for drug dealing. A case-control design is used as the research method for this dissertation because it enables the author to compare "locations of frequent drug dealing" with "locations free of dealing," and distinguish the differences in the physical environment of these two types of location. Such design helps this dissertation to determine the situational attributes that cause drug dealers to select certain locations and not others.

1. Choosing an Adequate Experimental Design

In most of the experiments in epidemiological and medical research, subjects of

interest are divided into groups that do and do not receive treatment. The researcher then compares the results of each group and projects back to identify the causal effects of the treatment on the subject (Shadish, Cook, & Campbell, 2002). This type of experiment, however, is not feasible when it comes to studying rare events (Shadish et al., 2002). In criminal justice research, a drug market problem is one topic that may not be studied by an experiment. It is not feasible to assign risk factors (the factors that attract drug dealing) to turn a regular location into a dealing location, nor is it ethical to implement risk factors in certain locations or communities, and expose them to needless harm. A more practical way to tackle these issues is to use a "case-control design" on the existing data.

In a case-control design, the "case" is a subject that has the outcome of interest, and the "control" that is to be compared does not. The association between the outcome of interest and the hypothesized causal factors is individually examined for each case-control pair, and then aggregated. The retrospective nature of case-control study makes it possible to determine which hypothesized causal factors are directly associated with the outcome being studied, as opposed to those that are associated by a shared cause (Dobrin, 2001). The cases and controls can be compared retrospectively to see if the difference between the case and the control is due to the hypothesized causes. In most research, the main objective of using case-control design is to identify possible risk factors that are related to the emergence of the outcome (Dobrin, 2001) The outcome in this type of design is typically dichotomous: yes-no or high-low.

The unmatched case-control design has many advantages, and has been considered a pragmatic method. It is frequently used when the subjects to be studied cannot be randomly selected (Shadish et al., 2002). It also allows easy examination of

multiple causes of a condition (Baker & Curbow, 1991 from Shadish et al., 2002:129). Using case-control design enables a study to be less susceptible to the ecological inference fallacy than other research designs when using aggregated data (Loftin & McDowell, 1988:86). For example, this design enables a study to be more reliable than quasi-experimental research designs (e.g. cross-sectional and time-series designs) when assessing the causal relationship between the independent variables and the outcome variable at the individual data level (Dobrin, 2001: 159). In addition, this design is considered to be relatively cheaper and logistically easier to conduct (Shadish et al., 2002:128). For example, it is more feasible than an experimental design when an outcome takes a long time to develop.

2. Why Matching? The Importance of Controlling Confounding Factors

A modification of the case-control design – direct matching between cases and controls – is used in this dissertation. A "matched case-control design," as opposed to a standard case control design, requires each case and control pair be matched according to some relevant confounding variables. A confounding variable is a third variable that is affecting the causality between the exposure factors and the outcome of interest (Shadish et al., 2002). In sociology research, confounders are often gender, age, socioeconomic status, occupation, and so on (Shadish et al. 2002). Confounding variables might bias the estimation of the outcome of interest, making it difficult to determine what the causal factor actually is. Controlling for confounding variables thus makes the cases and controls more comparable, and enhances the validity of the research design.

Drawn from a fictitious example (Himmelfarb Health Sciences Library, 2011), a study is interested in exploring the effect of a type of sunscreen element on preventing

skin cancer for lifeguards. The study compares a group of lifeguards with skin cancer to a group without the cancer and accesses their prior exposure to this sunscreen element. This medical study would need to ensure that the lifeguards in both groups are of the same age, and have worked a similar number of seasons. In this case, age and number of seasons are matched as confounding factors. If the study is unmatched on these critical confounding variables, then the result may lead researchers to conclude that lifeguards with cancer are older than those without cancer or that lifeguards with cancer worked more seasons under the sun, which interfere with the actual causality between the sunscreen element and skin cancer. The outcome may be affected by both the cause (exposure to the sun) and this confounding effect aggregately.

The use of this design is not new in the field of criminology (Loftin & McDowell, 1988:86). In Eck's (1994) study on the geography of illegal drug markets, he was among the very early studies that introduced the use of a standard case-control design in criminological research. Eck (1994) explored why a few places in San Diego, California, were persistent drug dealing locations while the majority of other places were not. He used the census block as a sampling base; a drug place was an address of a recorded drug arrest on a census block, and a control case was selected from the same census block. Another study by Hendricks, Landsittel, Amandus, Malcan, and Bell (1999: 995) used a matched case-control design to study convenience store robberies. They selected the convenience stores that had been robbed, and matched them to stores that had not. They matched the cases and controls on the store's business hours and locations, and found that numerous characteristics of the immediate environment and population were strongly correlated with convenience store robberies. Also, in the dissertation work by De Souza

(2010), she conducted a matched case-control study to examine the homicide problem in the Brazilian *favela* of Alto Vera Cruz. She compared the addresses with homicides to addresses without. In her study, the cases and the controls were matched according to the geographical space and time, which enabled her to compare the physical and social disorder characteristics around the locations.

Unit of Analysis

The geographic units of interest for this dissertation are micro places; they are street segments and intersections in Newark, NJ. To prepare a database suitable for executing analyses of drug dealing at micro places, a database for each street segment and intersection in Newark was prepared. Adopted from Braga at his colleagues (2010), street segments and intersections are treated as a single unit of analysis called the "street unit."

Street segments are selected for this analysis because they minimize possible errors from the miscoding of addresses in the data (Weisburd & Green, 1994). In reality, many locations of arrest recorded in this data are not the actual locations where the police encountered the arrestees. This fact was confirmed during the ride-alongs in Newark as well as from conversations with the narcotics unit officers, as described earlier in Chapter 2. Sometimes when a car chase occurred, the officer wrote down the end point of the car chase instead of the actual point where the drug dealing was first observed. There was usually another patrol car coming from the other direction, blocking the offender's escape route, and they often stopped the offenders soon after they were seen. Thus the end location was often still on the same street block as the observed location. Also, it is possible that police officers record street addresses as intersections on account of

convenience, which would make drug arrests at intersections an artifact of coding. In Newark, however, patrol officers are instructed by the departmental policy to specify street addresses of incidents when possible. It is in the interest of crime analysis reports that are organized by different "police sectors." When an incident is recorded with a street address, it is clear for crime analysts to allocate it to the proper police sector and investigate crime patterns. Furthermore, it is suggested by previous studies that crime events can be linked across street segments; for example, a drug market may operate across a few blocks (Weisburd & Green, 1995; Worden, Bynum, & Frank, 1994). Nonetheless, the street segment is considered by prior studies as a useful compromise because not only it minimizes possible crime coding errors, but it also avoid data aggregation (e.g. crime rate in a neighborhood level) that might hide unusual trends. On the other hand, intersections are also used in the analysis because many drug deals often happen on intersections, and dealers often drift up and down the blocks between intersections (Weisburd & Green, 1994; Weisburd et al., 1995). Recognizing these possibilities, both segments and intersections are chosen as the base unit for identifying active drug-dealing locations, called street units.

There are 6158 street segments in total in Newark, NJ, but not all are appropriate for the purpose of this dissertation. Some segments were screened out before launching the analysis. First, because street dealing points are where dealers and buyers meet on foot or by vehicle, above-ground highway roads are excluded from analysis. The original database provided by Newark Police Department includes information on the different types of street: whether a segment is a driveway, alley, service road, terrace, drive, lane, place, street, avenue, boulevard, parkway, connecting road, turnpike, highway, highway

exit, or whether it is an above-ground highway, and this information helps to identify and execute this filtering step. Second, the roads within the Newark Liberty International Airport jurisdiction are excluded. The reason for this is that the airport area is under the jurisdiction of the Port Authority Police, instead of the Newark Police. The Newark Police do not record crime incidents occurring in this area, except when required for multi-agency collaboration. According to the above two conditions, 1046 highways and airport roads are deleted from the dataset. In sum, there are 5112 total street segments viable for analysis.

The intersection database is formed with additional technical steps. The mapping software ArcGIS 10 computes the intersection point by identifying the points at which at least two lines intersect; thus the points where three or more lines intersect are also identified as intersection points. There are 4079 intersections in total in Newark, but for the same reason mentioned in the last paragraph, 1036 intersections are deleted from the dataset. In sum, there are 3043 total intersections for analysis. Overall, there are 8155 street units used in this dissertation.

Data Sources

1. Police Arrest Data

The primary data used in this dissertation are the drug arrest records. It is noted that prior studies have suggested using calls for service data as a more proper measure of crime activity than arrest data (Weisburd & Green, 2000; Sherman et al., 1989; Warner & Pierce, 1993). One concern in analyzing spatial patterns from arrest data derives from the fact that those were places that received a great deal of police attention. The distribution of citizen's calls for service is less affected by patterns of police enforcement (Sherman et

al, 1989; Warner & Pierce, 1993). For example, a high rate of drug offense charges within the downtown could be explained by the overall quantity of police traffic enforcement in the area in which the chance of a person being pulled over for a traffic violation but getting caught possessing drugs multiplies. Nonetheless, prior studies have emphasized the extent to which the police deployment in a city is in fact a reflection of the requests of citizens' calls for service (i.e. Mazerolle, Rogan, Frank, Famega & Eck, 2005). Similar portraits of crime concentration are also found when detecting other types of hot spots, such as drugs and disorder (Lum, 2003; Weisburd & Green, 1994).

Weisburd and Green (2000) suggested a combination of arrest data and calls for service to gauge the level of local drug activities. When including the calls for services data, however, Weisburd and Green (2000) noted that they only included the addresses at which the callers said the incident occurred, rather than where the calls were made. This raises concern over the memory and reliability of the callers. In their study on juvenile crime, Weisburd, Morris, and Groff (2009) addressed the fact that arrest reports provide the most detailed information; however, arrest reports provide a measure of "offenders" rather than "offenses." For example, multiple drug offenders may be arrested and reported separately from one drug offense. This indicates the importance of identifying arrest reports related to multiple arrests when analyzing drug dealing incidents. Moreover, Warner and Coomer (2003) examined the accountability of using drug arrest data for measuring drug dealing at the neighborhood level, as well as the extent of police discretion. Their findings supported the use of drug arrest data as a meaningful measure of the relative level of visible drug activity among neighborhoods. Arrest records are thus considered here as a valid measure to reflect drug activities on the street level.

The data was obtained from the Newark City Police Department, which contains drug arrest records from January 2007 to December 2009. This dataset contains information on the date, time, and physical address of each arrest, the police unit which made the arrest, and the criminal charge. It provides the necessary information for the statistical analyses in the later chapters.

Match Rate of Geocoded Addresses

Geocoding addresses means that an address written on the police report can be pinned to a spot on a map. A column indicating the original locations of arrest (LOA) in the database was first identified. Using the mapping software ArcGIS 10, these original arrest locations are geocoded on the map, generating a column called "matched address" and a column shown in the form of *X,Y* coordinates. There are 7115 total drug arrests recorded in Newark during 2007: there is a 93.07% match rate (n = 6622), 6.07% (n = 432) are tied and 0.86% (n= 61) are unmatched because of missing or miscoded addresses. There are 7903 total in 2008 with a 91.79% match rate (n = 7254), 7.09% (n = 560) are tied and 1.13% (n= 89) are unmatched because of missing or miscoded addresses. There are 7870 in 2009 with a 91.13% match rate (n = 7172), 8.03% (n = 632) are tied and 0.84% (n= 66) are unmatched because of missing or miscoded addresses. Using both matched and tied addresses for further analysis, there are 7054 arrest cases from 2007, 7814 cases from 2008, and 7804 cases from 2009.

It is noted that some original arrest locations are written as a range without specific location point: for example, 65-85 Manor Drive. These locations were arbitrarily matched at the midpoint of the two numbers, i.e. in this case 70 Manor Drive. Each instance of this type of range is inspected and verified to be located on a single segment,

which means its midpoint would still represent the same segment. If this dissertation were to analyze arrest "addresses," then accurately specified address with house number would be required and these arrest location ranges would have to be eliminated to assure valid and good-quality data for analysis. Since this dissertation is examining arrests on each segment, the arrest addresses and each of these midpoints can be tallied in terms of segments. Thus, this does not compromise the data quality for this analysis. There are 79 arrest locations in 2007, 52 in 2008, and 61 in 2009 that are recorded in this manner, which do not affect the data analyzed. All the arrests on intersections were recorded clearly.

2. Physical Environment Data

(1) Systematic social observations via Google Street View

This research utilizes the Google Street View (GSV) tool to collect environment data in Newark, NJ. Google Street View, a technology integrated in Google Maps and Google Earth, was released in May 2007 in several cities in the United States, and has expanded to cover cities and rural areas worldwide. GSV provides 360° horizontal and 290° vertical panoramic views every 10 to 20 meters on most of the streets in major U.S. cities, which enables users to navigate street-level images as if they are driving through the streets. These images make it possible to visually identify situational factors and the degree of physical disorder. The GSV provides high-resolution street images from every angle for most streets in Newark, NJ, except for some newly built roads and small alleys that cannot be viewed. GSV images are updated every few years. GSV images for Newark were dated mostly between 2012 and 2014 during the time the observational data was being collected.

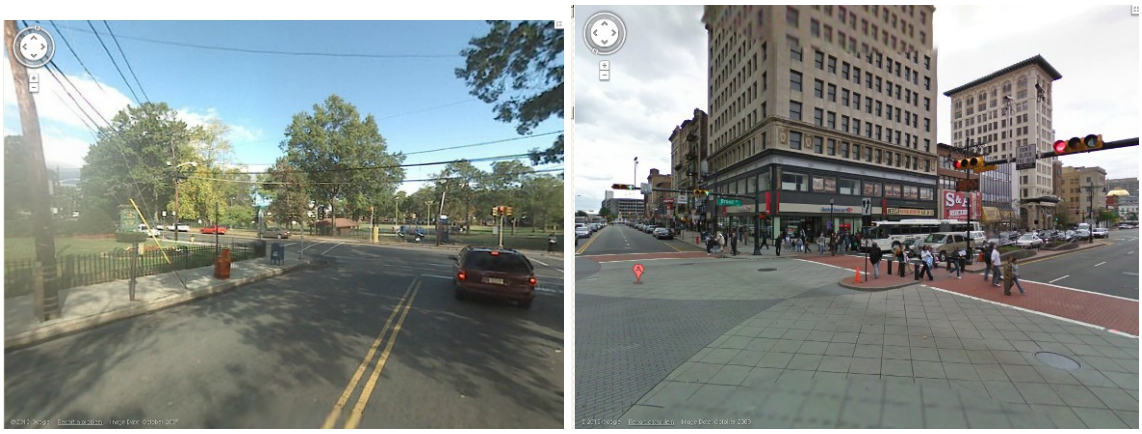


Figure 12 GSV images of Newark

The capacity and coverage of GSV has continuously expanded worldwide over the years, although the viability and benefit of using GSV in scientific research is still uncertain. A few epidemiological and sociological studies have found that GSV can be a suitable alternative to audit neighborhood environments instead of in-person social observation, which is known to be often time-consuming and expensive to conduct for research (Clarke, Ailshire, Melendez, Bader, & Morenoff, 2010; Rundle, Bader, Richards, Neckerman, & Teitler, 2011; Odgers, Caspi, Bates, Sampson, & Moffitt, 2012). In a study in Chicago, Clarke and her colleagues (2010) found that using GSV as the virtual neighborhood audit instrument can provide reliable indicators of recreational facilities (playgrounds, parks, and sports fields), local food establishments (fast food restaurants, bars, convenience stores), and general land use (housing type, commercial, industrial, or institutional use). In a study in Auckland, New Zealand, the researchers used GSV images to examine the association between the built environment and physical activities (Badland, Opit, Witten, Kearns, & Mavoa, 2010). They found GSV to be a reliable and resource-efficient alternative to physically auditing neighborhood streetscapes by foot or bicycle. In a study in New York City, Rundle and his colleagues (2011) use GSV to audit

neighborhood features and their impacts on public health, and found that GSV images of pedestrian safety, traffic and parking, and infrastructure for street travel show high concordance with field audit observations. In a study in suburban and urban areas in St. Louis and Indianapolis, the researchers assessed the reliability of GSV images on land use data and socioeconomic characteristics, and found substantial agreement between field audits and GSV (Kelly, Wilson, Baker, Miller, & Schootman, 2012). However, most critically, all these studies above found inconsistent concordance while comparing GSV images and field audits on physical disorder characteristics. In Rundle et al. (2010), caution was addressed for using GSV to measure features that are small and typically show temporal variability, such as garbage, broken glass, litter, graffiti, signs advertising alcohol, etc., and they suggested finer definition is needed to measure these characteristics.

The viability of using GSV in crime research - for example, in studies of neighborhood disorganization - is rarely addressed. In a more recent study on environmental risk and anti-social behavior in children in England and Wales, Odgers and her colleagues (2012) demonstrated that GSV might be a reliable tool for measuring neighborhood characteristics indicating signs of physical disorder (street littering, graffiti, and abandoned vehicles), physical decay (sidewalk condition and deteriorated buildings), the dangeroand safety of streets. In a study on motor vehicle theft in Newark, NJ, because no data existed on vehicle distribution at street level, Fujita (2011) utilized GSV images to identify particular vehicle types and manually counted the vehicles parked on streets in Newark, NJ. Fujita's (2011) dissertation and Odgers et al. (2012) were among the earliest studies to directly examine neighborhood characteristics and crime using GSV as the

measurement tool.

(2) Data collection instrument

This dissertation established a GSV data collection instrument (see Appendix) for collecting situational variables observed on street segments and intersections in Newark. It is developed and modified based on the observation instrument invented by the Adaptlab of the University of California, Irvine. The researchers Odgers, Bates, Caspi, Sampson, and Moffit (2009) invented a systematic social observation instrument, called SSO i-Tour, which tallies observations, particularly in urban regions, using Google Street View.

This data collection instrument first asks the rater to specify the name of the location, whether it is a segment or intersection, the date of the GSV images, and the coding date. 11 situational variables are included in this instrument[4], of which all variables are dichotomous variables (Yes/No). For the variable *retail business-related store,* if any convenience store, grocery store, liquor store, bar, take-out food, pawnshop, barbershop, or nail salon is observed, the variable will be coded as Yes.

In particular, to collect factors on an intersection, it is first clarified that there are at least three corners constituting an intersection (illustrated in Figure 13). Thus, when a factor touches any of the immediate corners, it should be counted and marked on the instrument. For example, if a mailbox is located at one of the immediate corners, it should be marked on the instrument as "yes," but if a school campus touches one *corner* of an intersection and expands throughout half of the adjoining segment, then it cannot be considered as a factor for the drug dealing on that intersection.

[4] The dichotomous variable *highway* is separately coded using the ArcGIS program. The ArcGIS program calculates the geographic distance between each case and the nearby highway.

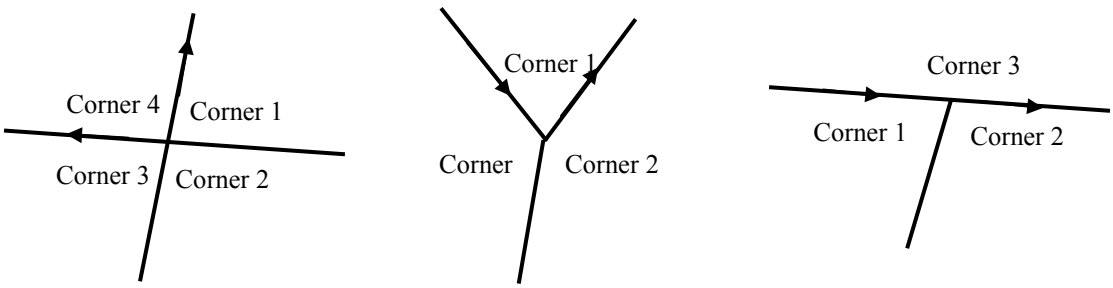


Figure 13 Examples of different intersection types
Note. Modified from Nielsen, Israelsen, & Nielsen (1997)

(3) Challenges of using Google Street View

Google Street View enables the dissertation to quickly access images of the physical environment around the streets sampled, and it offers images precise enough for users to estimate physical factors on the streets. There is a large number of situational characteristics addressed in the previous literature; however, not all are applicable to this dissertation for the following main reasons:

- **Temporal Variability**

Some of the characteristics constantly change over time and cannot be accurately presented by GSV. For example, a bench used by a dealer waiting for a customer (Myhre, 2000) may be moved around and may not be captured on GSV, and a black plastic trash bag tied to the fence outside a project housing used for dumping drug paraphernalia (Myhre, 2000) may be removed by street cleaning service and not shown on GSV. Rundle and her colleagues (2011) suggest that physical features that are small or related to physical disorder, such as garbage or litter, typically exhibit temporal variability. It is found to have lower levels of concordance between the Google Street View images and the actual field audit data. Therefore, the principle of using GSV here in this dissertation is that the situational characteristics that are temporally stable will be included for

analysis in this dissertation.

- **Image Unavailability**

There are some missing observations in the sample dataset; particularly the small alleyways and new roads built after the street images were taken. The Google Street View cars did not drive through these places and did not capture the street images. In total, there are seven case streets not observable on Google Street Views (six of them have their paired control streets also not observable on Google Street Views because they are the same type of small alleyway nearby). Therefore, the principle of using GSV here in this dissertation is that the situational characteristics must be directly accessible and observable through Google Street View.

Sampling Procedures

In this dissertation, the cases are the street units that have repeat drug-dealing activities, and the controls are those that are free of drug dealing activities. The case locations are selected from the police arrest data, and the control locations are selected from the same geographical area (Miettinen, 1985). To do so, the cases are sampled based on the frequency of arrests, and then the controls are manually sampled to pair with each case. Once the matching process is completed, the case-control pairs can be used for further analytical comparison. In sum, the sampling procedure is performed according to the following steps: (1) taking into account the statistical power, a sample size is determined, (2) using 2007-2009 arrest data to identify all locations that are possible street drug markets, (3) selecting locations with the highest frequency of arrests in 2007-2009 to be the cases, and (4) selecting locations without any arrest in 2007-2009 to be the controls, matching on several confounding variables.

1. Sample Size

There are 665 street units (433 segments and 232 intersections) in Newark known to the police that have experienced drug activity. They may not all be actual active dealing locations. Thus, not all 665 street units are included, in order to capture cases that are unarguably active dealing locations. This section addresses the guidelines for determining a reasonable sample size that is efficient for detecting significance and statistical power. This section also discusses the guidelines for determining the number of controls in relation to each case.

This dissertation intends to test the statistical significance of individual independent variables (bivariate analysis). These specific causal models are grounded in criminological theories, which require less concern over the sample size. This dissertation also intends to assess overall prediction (multivariate analysis), and a larger sample size makes it more reasonable to allow more predictors in a model. As addressed in Lipsey (1990), to ensure that the conclusions about the research design are correct, the design must have both validity and sensitivity. Validity refers to the likelihood that what is measured is in fact the effect of interest. Sensitivity refers to the ability to detect a difference between the intervention and control conditions on some outcome of interest. In the statistical term, we are seeking an effect if an appropriate statistical test indicates a statistically significant difference between the intervention and control means. In this dissertation, the goal is to minimize Type II error (β), the failure to find statistical significance when in fact there is an effect, so that the statistical power ($1 - \beta$), the ability to detect a statistical significance when there is in fact an intervention effect, will be maximized. To determine an acceptable Type II (β) error, Cohen (1988) suggested β =

0.20 as a reasonable value for general use, i.e. he suggested that statistical power $(1 - \beta)$ to be at least 0.8.

Thus, the target for the initial sample size is determined to be at least 134 paired street units, i.e. 134 drug-dealing street units and 134 dealing-free street units. This decision is computed based on the goal of achieving a 0.05 confidence level (a conventional value for α, the Type I error), to detect an odds ratio of 2.0 or greater, and to achieve an 80% chance of detecting a real difference between exposure to situational risk factors and the lack thereof (*power*), with the assumption that the rate of exposure among the controls is 20%. It is also preliminarily decided to have an equal number of cases and controls, and to conduct one-sided tests on hypotheses.[5]

Specifically, in order to assess the relative importance of predictors, it is determined that both the bivariate relationship between each predictor and the outcome, and the relationship between each predictor and the outcome holding other predictors constant will be analyzed. Since the 10 predictors included here are likely to be inter-correlated, interpretation of the bivariate relationships can be useful, since a predictor important in a bivariate relationship might be hidden in a model by other correlated predictors. Thus, a minimum of 134 paired street units is used to allow all the independent variables to be examined in an overall model.

2. Profile of Active Dealing Locations in Newark

The use of a matched case-control design hinges on the accuracy of identifying cases. For a crime problem like drug dealing, it is very difficult to know with certainty that there is no drug dealing at a given place. The absence of police arrests made at a

[5] The values are computed through the use of an online webpage http://sampsize.sourceforge.net/iface/s3.html#cc

location may mean that the dealer has been very clever and elusive, and has not been apprehended by the police. Similarly, it is possible that a location indicated by arrest records to be a dealing place is in fact a non-dealing location. For example, the residents of a house do not deal drugs, but one evening they have many guests over for dinner and one of the guests is involved with dealing activities. The police are informed and respond to the address, and the address is then reported and identified as a dealing location.

To reduce the chance of making such errors described above, multiple years of arrest data are used to examine any pattern of dealing. This is because locations with recurrent drug activity might be overlooked if only a single year's data is used. Drawn from Eck's (1994) work, locations that showed a "persistent pattern" of dealing activities can be considered drug dealing places for analysis. This reduces the chance of selecting locations that are the result of random error or temporal fluctuation. This selection process enables the identification of the most notorious and persistent active drug markets in Newark during this time period. Aside from using police arrest records to indicate possible dealing locations, additional opinions from narcotics unit officers are also obtained, although primarily, the analysis is focused on the drug arrest records.

Determining Arrests Suitable for Analysis

During the initial screening of the drug arrest records, it was noted that only a few street segments were repeatedly recorded for dealing activities, in relation to a total of 5112 segments in Newark. To identify the critical indicators of the most active drug market locations, the identification procedure begins by determining which streets and intersections are suitable for the purposes of this dissertation.

It was noticed that some drug arrests are made with warrants or other

investigative functions, which are not directly related to the subject of this dissertation. The subjects of study in this dissertation are the dealing activities either committed on streets, detected by the patrolling officers, or by the officers responding to witnesses' calls. In other words, the dissertation is interested in arrests made during regular patrols. Records of arrest that are not made on patrol are excluded. This dataset contains a column indicating the police unit that made the arrest ("Current Assignment"). Under this column, it shows whether the arresting unit was an investigative unit or a particular precinct unit, which are the investigative units of the Newark Police Department that do not have any proactive patrol duties. If the arrests were the result of narcotics investigations, the arrest locations are most likely not the locations of incident. Thus any arrest incident matching this condition is excluded from analysis. After filtering these records, there remain 6880 arrests in 2007, 7731 arrests in 2008, and 7712 arrests in 2009.

Stable Ratios of Arrests on Segments and Intersections

In 2007, about 76.40% of arrests are matched to specific addresses on segments (5256 of the 6880), and 23.60% of arrests are matched to specific intersections (1624 of the 6880). In 2008, about 77.89% of arrests are matched to a specific address on a segment (6022 of the 7731), and 22.11% of arrests are matched to a specific intersection (1709 of the 7731). In 2009, about 70.97% of arrests are matched to a specific address on a segment (5473 of the 7712), and 29.03% of arrests are matched to a specific intersection (2239 of the 7712). The numbers and percentages are summarized in Table 2 below.

This multi-year examination confirms the fact that there is a significant and stable portion of drug arrests made at intersections, distinguishable from the portion made on

segments (Table 2). Thus, there is a need to separately address dealing activities that occur on segments and intersections.

Table 3 *Number and Percentage of Arrests on Segment and Intersection in 2007- 2009*

Year	**Segment**	**Intersection**	**Total Arrest (%)**
	# Arrest (%)	**# Arrest (%)**	
2007	5256 (76.40)	1624 (23.60)	6880 (100)
2008	6022 (77.89)	1709 (22.11)	7731 (100)
2009	5473 (70.97)	2239 (29.03)	7712 (100)

Stable Geographic Concentration of Drug-Dealing Activities

Using the ArcGIS 10 Spatial Join Analysis tool, the geocoded locations are aggregated to specific street segments and intersections for 2007 to 2009. The tallied counts of arrests on each street unit confirm the findings of previous literature that indicated there are often clusters of crime in a city, while a large portion of the city is free of crime (e.g. Weisburd and Green's study at Jersey City, 1994). Figures 14 and 15 show that approximately 80% of the street units in Newark experienced no arrest across the three years examined here. Conversely, about 1% of segments and 0.1% intersections experienced more than 20 arrests in each of the three years. This indicates that dealing activities are always concentrated at less than 20% of the locations in Newark. Drug dealing activities are distributed at a persistent portion of locations within the city.

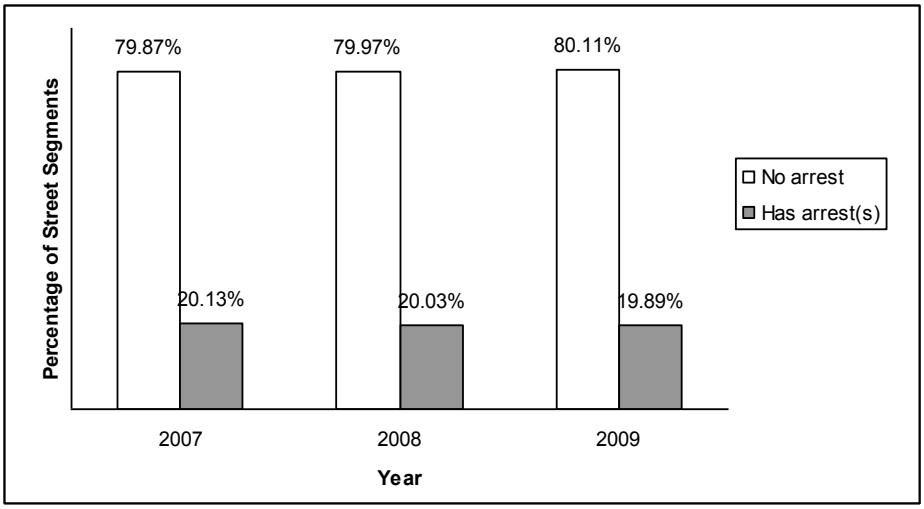


Figure 14 Year-to-year concentration of arrests on all street segments in Newark

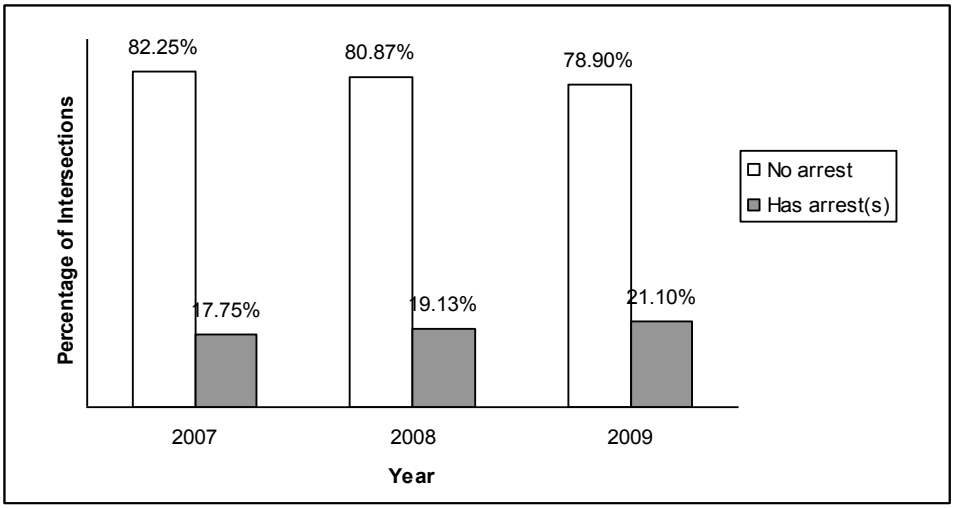


Figure 15 Year-to-year concentration of arrests on all intersections in Newark

Importantly, it is noted that some street units do not show persistent drug activity across the time period (see Figure 16): there are fluctuations in the number of arrests on each of these street units for the 3-year period. Figure 16 reveals that the locations with high dealing concentrations are not necessarily the same locations from year to year. For example, a street segment shows more than 30 arrests in 2007, five arrests in the next

Figure 16 Signs of drug market movement in Newark

year, and one arrest in 2009. An intersection experiences four arrests in 2007, no arrest the next year, and more than 15 arrests in 2009. This finding indicates that the arrest numbers are not consistent across all street units. There might be a good deal of drug market movement from location to location. It is thus necessary to take care not to select street units that fluctuate too much across these years.

A closer examination of the parametric correlation matrices of the dealing locations over the three years (Tables 3 and 4) shows that the year-to-year counts of arrests on street segments are significantly correlated at a moderate level, and the significantly moderate correlation also occurs on intersections. The tables indicate that the number of arrests on the specific street segments correlate with the number of arrests in neighboring years to a moderate extent. The significant but moderate correlation suggests that there might be fluctuations at some of the high-dealing locations. These findings reaffirm that the geographic distributions of street dealing activities change from year to year. Thus, this dissertation seeks particular locations with persistently high dealing levels to be the active drug market locations.

Table 4 *Year-to-Year Correlations of Arrests on Street Segments*

Year	**2007**	**2008**	**2009**
2007	1.000		
2008	0.756**	1.000	
2009	0.642**	0.738**	1.000

**. Correlation is significant at the 0.01 level (2-tailed). N=5113

Table 5 *Year-to-Year Correlations of Arrests on Intersections*

Year	**2007**	**2008**	**2009**
2007	1.000		
2008	0.680**	1.000	
2009	0.664**	0.770**	1.000

**. Correlation is significant at the 0.01 level (2-tailed). N=3043

3. The Cases: The Most Active Dealing Locations

This section illustrates the screening and filtering steps taken to determine what segments and intersections to use. It is first determined that locations with a disproportionately high amount of drug arrests should be sought, and that the records of drug activity should persist over time (Eck, 1994). The previous section has demonstrated that a portion of street drug dealing locations were fairly stable from 2007 to 2009.

Determining the Threshold Criterion

First, it was decided to sample street units that have persistently high drug activity over the 3-year period for the case group. Modified from the study by Weisburd and Green (1994) in Jersey City, NJ, a threshold method was established. A street unit that experienced recurrent dealing activity across multiple years is considered a hot spot.

Aggregately, 65.45% of total Newark segments experienced no drug arrests during the 3-year period (3346 of the 5112), and 65.99% of total intersections experienced no drug arrests (2008 of the 3043). Conversely, Figure 17 shows that there are 20 segments (0.39% of the 5112 total segments) that experienced at least 20 drug arrests in all three years; 47 street segments (0.92% of the 5112 total segments) that experienced at least 10 drug arrests annually from 2007 to 2009; 104 segments (2.03% of the 5112 total segments) that experienced at least five drug arrests; 255 segments that experienced at least 2 drug arrests (4.99% of the 5112); and 433 segments (8.47% of the 5112) that experienced at least 1 drug arrest annually from 2007 to 2009. In addition, 1333 segments (26.08% of the 5112) experienced significant fluctuation in the level of dealing activity across these years. On the other hand, there is one intersection that experienced at least 20 arrests in all three years; there are 4 intersections (0.13% of the

3043 total intersections) that experienced at least 10 drug arrests in all three years: 31 intersections (1.02% of the 3043) that experienced at least five arrests; 115 intersections (3.78%) that experienced at least 2 arrests: and 232 intersections (7.62%) that experienced at least one arrest. In addition, 803 intersections (26.39% of the 3043) experienced significant fluctuation in the level of dealing activity across these years.

Figure 17 reveals that using "five arrests" as the threshold point meets the requirement for a sample size of at least 134 street units. This threshold yields 104 segments and 31 intersections. There are, thus, 135 street units selected as the cases (see Figure 17); about 77.04% (104 of the total 135 units) are segments and 22.96% (31 of the total 135 units) are intersections, which is similar to the distribution of total drug arrests on segments and intersections described previously (see Table 2).

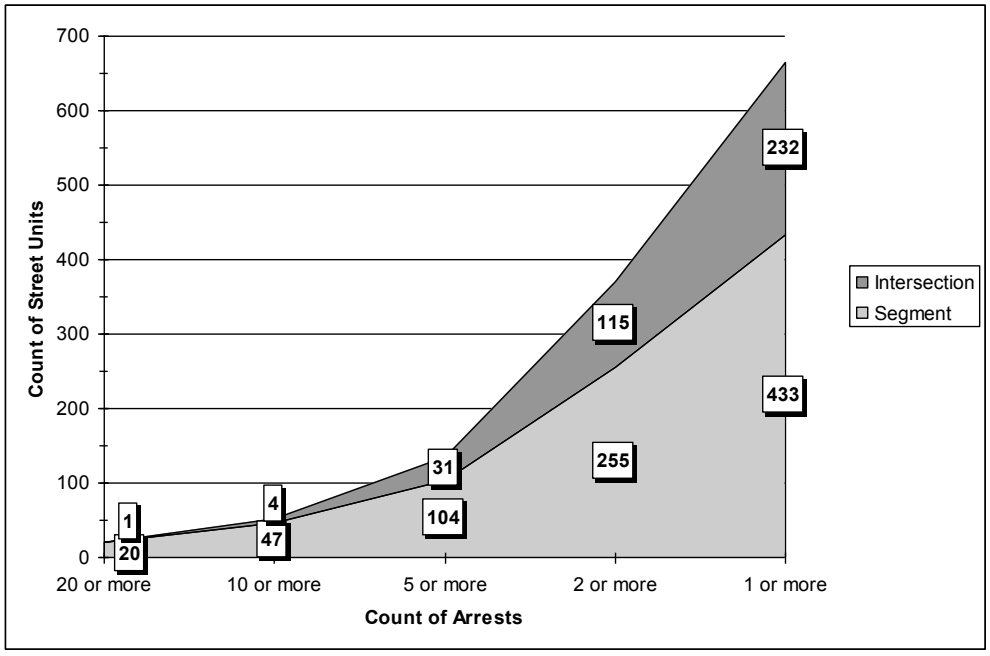


Figure 17 Accumulative counts of arrests, 2007-2009

In sum, the case selection steps are listed as below:

1. Exclude arrests made as the result of narcotics investigations
2. Tally the counts of arrests in 2007-2009 for each street unit
3. Select street units with at least five arrests per year to be the cases, i.e. persistent active dealing locations. This step yields 104 segments and 31 intersections.

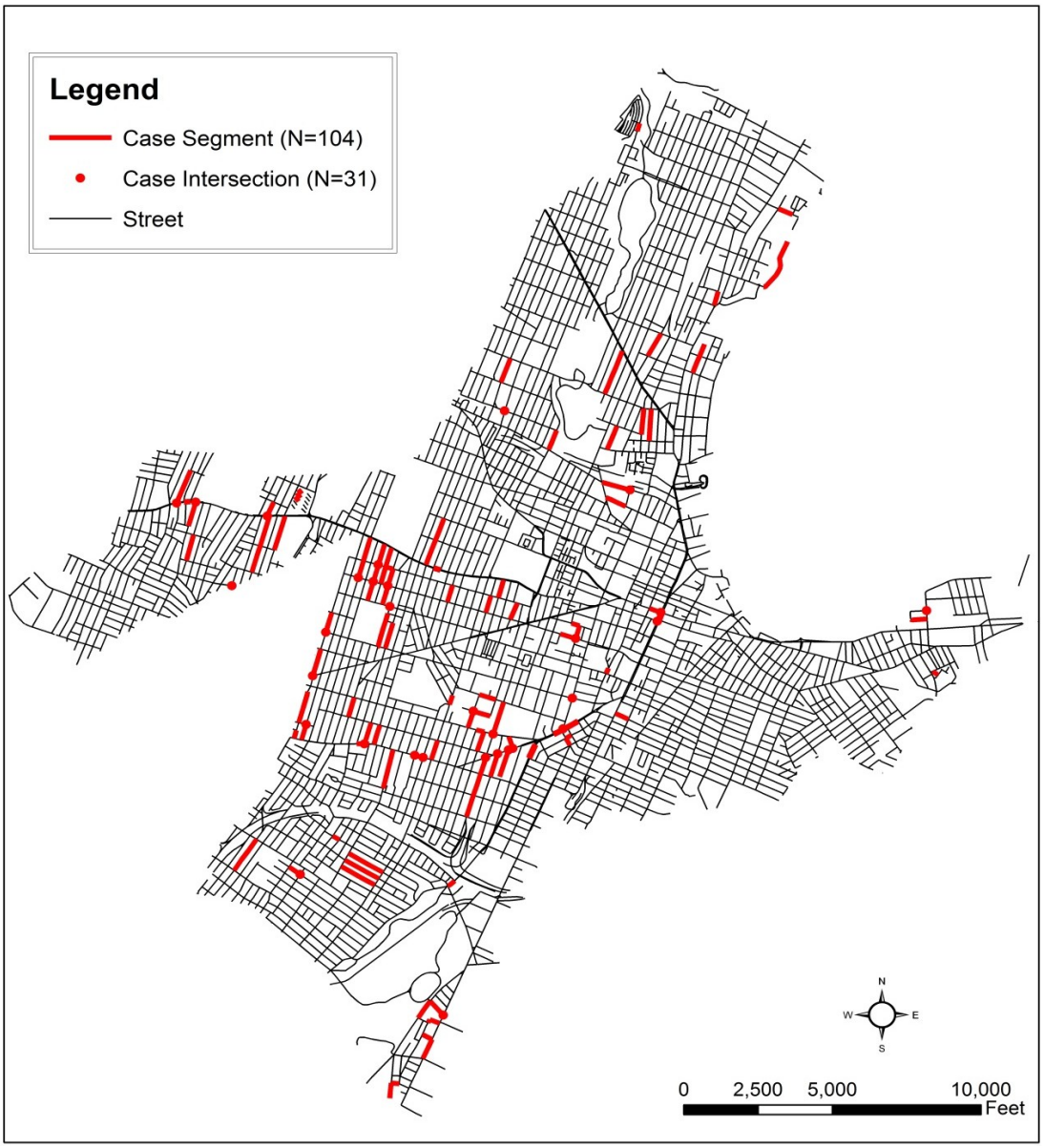


Figure 18 Active drug-dealing segments and intersections (N=135), 2007-2009

4. The Controls: Locations Free of Dealing

It has been addressed that the cases and controls should be selected from the same study base (Miettinen, 1985). In this dissertation, controls are individually selected as pairs for each case. The cases are selected based on the 2007-2009 arrest records, so in accordance with this principle, the controls are also selected from a pool of street units that are arrest-free during the same time period.

What to Match?

Control segments are selected individually to match cases according to two confounding variables: First, segment length, meaning that each control street segment should have the same or similar length as the paired case segment. Segment length is predictive of the number of arrests, because it is likely that a longer street segment will be associated with more arrests. Second, the control segments are matched on the "distance" from the case, meaning that each control segment should be located as close to the case segment as possible.

On the other hand, control intersections are selected individually to match with cases according to two confounding variables: First, major thoroughfare, meaning that each control intersection shares an intersecting thoroughfare with its paired case. For example, one case intersection is Hillside Ave and Clinton Ave, and its paired control is Hillside Ave and W. Alpine St. In such situations, these two intersections are located on the same major thoroughfare. Second, the control intersections are also matched on the "distance" from the case. Each control intersection should be located as close to the case intersection as possible.

Offender mobility literature suggested that offenders do not travel beyond one

mile (Eck, 1992). In a growing drug market where there is a potential for significant profit, new competing dealers are likely to locate their business as close as possible to the already existing sales location in order to siphon off the excess profits (King, 1984). It is likely that illegal drug dealers will resort to violence if there is conflict with competing dealers, but when the profits are large enough, empirical studies have demonstrated that more than one dealer can operate on the same street block without violence (Cooper, 1990; Eck, 1994; Rengert, 1996). Having recognized that dealers tend not to drift far from their primary point of dealing, Weisburd and Green (1994) used one block as the radius defining a drug area.

Using a broader search radius, some recent studies examine crimes within a three-block radius. Hakim and Shachmurove (1996) found commercial establishments located within three blocks of heavily traveled thoroughfares to be less vulnerable to burglary than those located further away. Wilcox and colleagues (2004) asked respondents about the presence of various public facilities within three blocks of their homes, and found strong positive effects on the risk of violent victimization. In Weisburd, Groff and Yang (2010), authors analyzed their variables within a 1,320 foot distance (i.e. one-quarter mile) of each street segment sampled, which is about the length of three street segments.[6] Determining what causes one location within a small zone to be selected while another is not is extremely helpful in determining the most salient situational characteristics (Rengert, 1995:72). Thus, "distance" between the drug dealing location (case) and the paired drug-free location (control) should be matched to make the comparison more

[6] This is because in this study each street segment is considered as the surrounding three-four street segments. The average length of a street segment in their study site, Seattle, is approximately 400 feet. Thus, assuming all the surrounding streets are about average, 1,320 feet (one-quarter mile) distance is just over three street segments.

powerful.

Sampling the Controls

The "Selection by Location" function in the ArcGIS 10.0 mapping software enables the user to select units based on structured query language (SQL). In the initial attempt to select a control sample, it was set to capture segments that are "within a 100-meter radius" of each case street (De Sousa, 2010). However, the examination of street patterns of drug activity showed that most of the neighboring streets within the 100-meter radius of the case streets experienced some level of dealing activity. This finding is in line with the work of Weisburd and Green (1994) and Eck (1994), which indicated that drug market activity is likely to extend in an approximately one-block zone from a drug arrest point. Citing the search radius of Weisburd and colleagues (2010), it was then determined to use a three-block radius to sample the controls. Because the average length of a street block in Newark is approximately 371 feet, a search radius of 1,114 feet (three street blocks) distance is used as a result.

Using the ArcGIS 10.0 program, the Selection by Location function is performed separately for each case street, and the program yields a list of all candidate street segments within a 1,114-feet radius of each case street. Each case segment has multiple candidate controls ranging from three to 71 possibilities within the 1,114-feet radius. The segment that is most similar in length to the case is selected to be the control. Out of the 104 case streets, 30 streets yield conflicting matches. Conflicting candidate matches happen when two case streets are neighboring, and there is only one proper candidate matching a street and all other streets in the 1,114-feet radius experienced at least a few drug arrests during the time period. It is thus determined that the candidate street will be

assigned to the case street that is geographically nearest, and then a search is performed for streets within a 1,114-feet radius of the other case with one drug arrest (see Figure 19). A similar sampling procedure is also performed for each case intersection, and the ArcGIS program also identifies a list of all candidate intersections within a 1,114-feet radius of each case intersection. The viable intersection nearest to each corresponding case intersection is selected to be the control (see Figure 20).

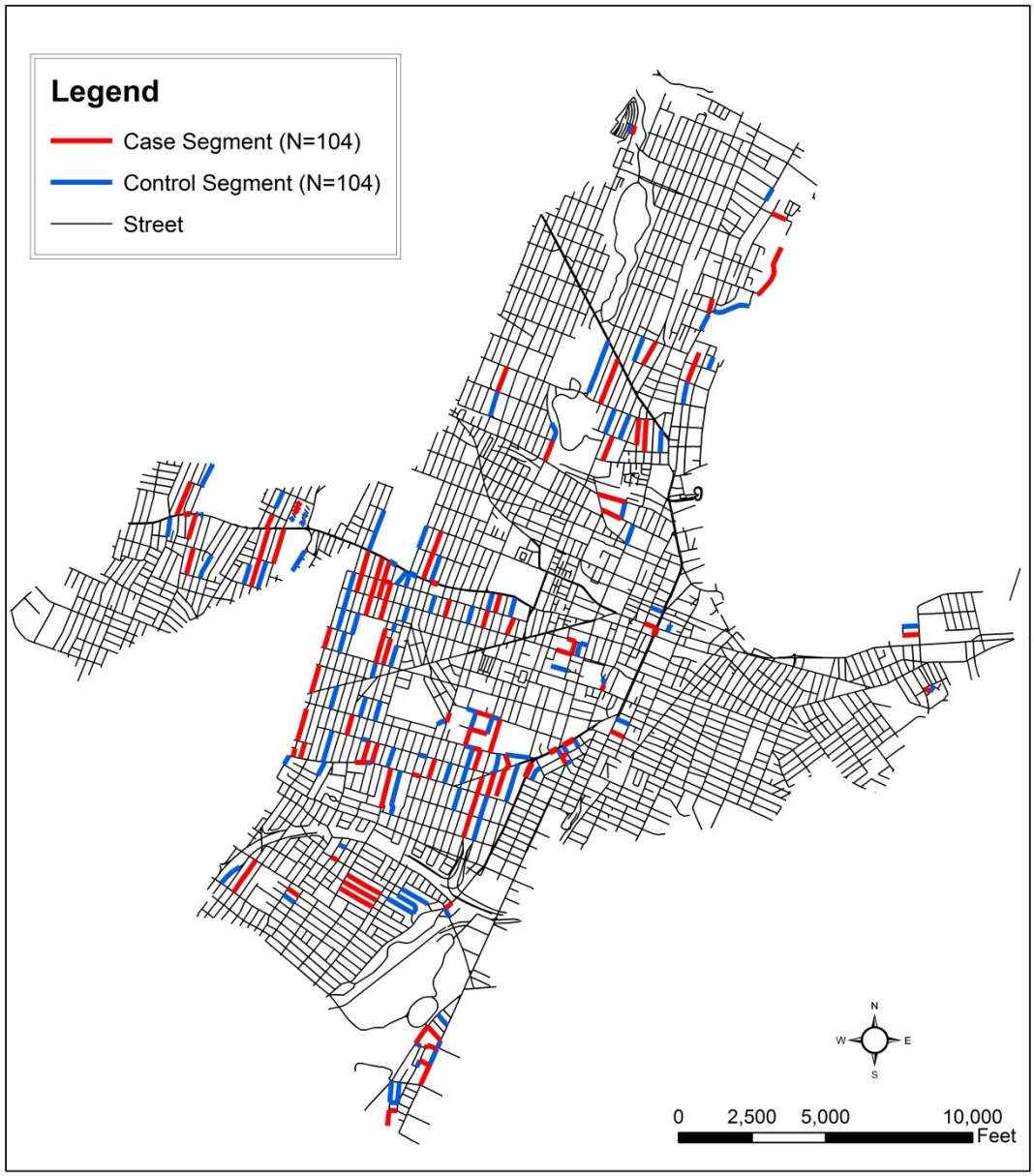


Figure 19 Matched case and control segments

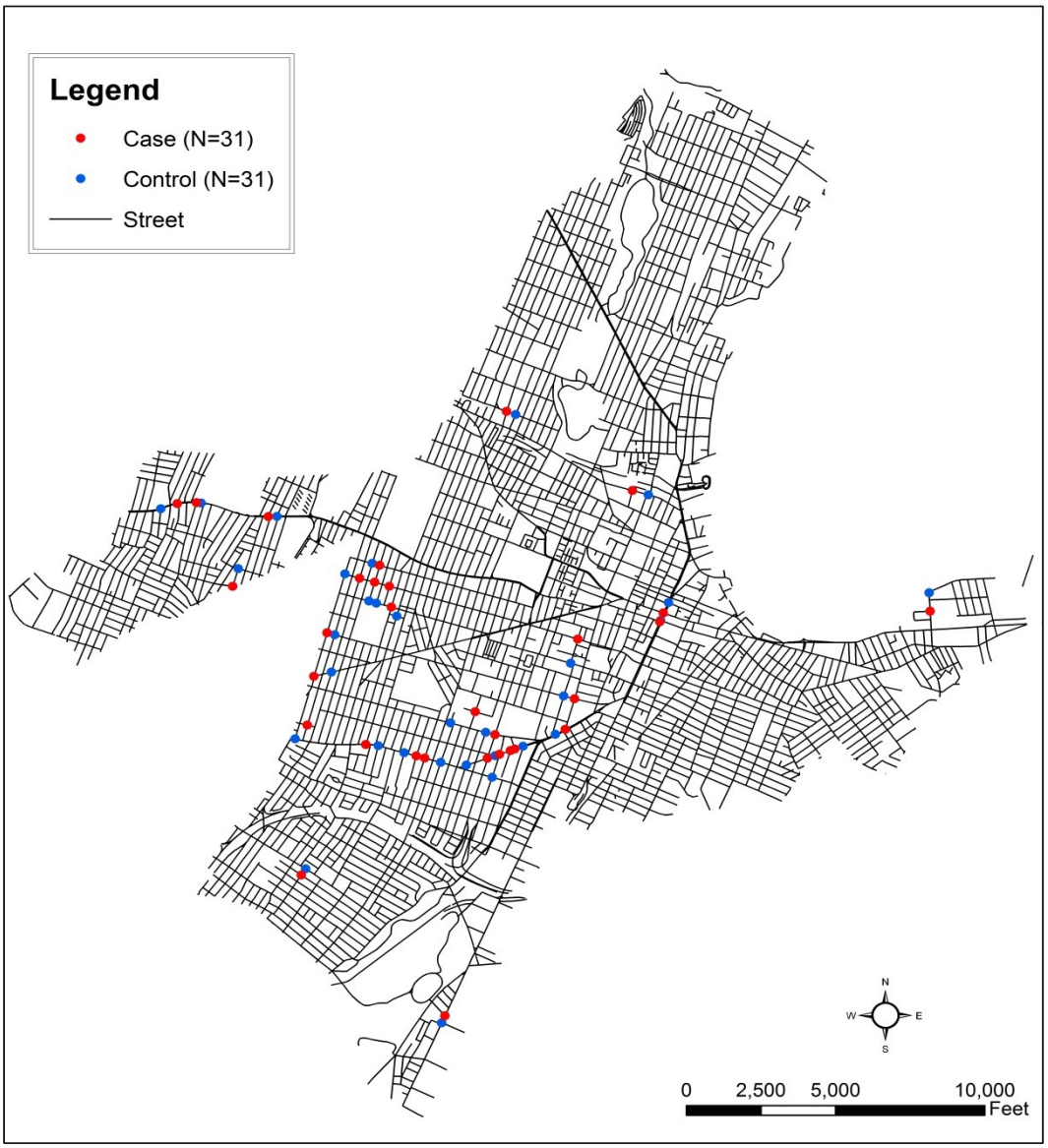


Figure 20 Matched case and control intersections

In sum, the control selection steps are listed below:

1. Tally the counts of arrests for each street unit in 2007-2009.
2. Include street units with zero drug arrests from 2007-2009 in the control pool, i.e. dealing-free locations. The control pool has 3346 segments and 2008 intersections.
3. Use a 1,114-feet search radius for each case street unit to capture all street units with no arrests in 2007-2009. This step yields a list of candidate control street

units for each case street unit.

4. To select one control street unit:
    a. Select the candidate segment having a length most similar to the paired case segment, i.e. less than 10% deviation from the paired segment, to be the matching control segment.
    b. Select the candidate intersection that is sharing the same major thoroughfare as its paired case to be the matching control intersection.
5. Identify any street unit assigned to more than one case. For all the repeatedly selected street units, each is assigned to the case street unit that is geographically closer. The other case street unit then repeats step 4 to select the next suitable control street unit.
6. If step 5 is not applicable, then the case street unit repeats step 3 and searches for all units within its 1,114-feet radius with one drug arrest, and continues with step 4.
7. In addition, when the case street unit is in a defined community, then the matching street unit will be selected from the same community.

Inter-Rater Reliability

Neighborhood observation items, such as street litter, abandoned buildings, or vacant land, often rely on some degree of subjective interpretation by the observers (Viera & Garrett, 2005). In the classical test theory (Lord, 1959; Novick, 1966), observed scores from the coding instruments are assumed to be composed of a "true score" that represents the item's score that would be obtained if there were no measurement error, and an "error component" that results from measurement error (also called noise), such

that

Observed Score = True Score + Measurement Error

This dissertation examines the agreement between the two raters by including the raw agreement (as a reference), Cohen's *kappa* statistic, and also the intra-class correlation statistic. There has been little consensus about the default way to assess inter-rater agreement, or researchers often report incorrect inter-rater reliability statistics (Maclure & Willett, 1987 from the website; Hallgren, 2012). The comparison of more than one reliability-check method will help in determining the items reliable enough to be observed from Google Street View images. The comparisons are illustrated in the following.

1. Raw Agreement

The raw agreement is the *proportion of overall agreement* (Po), meaning the proportion of cases for which rater 1 and 2 agree. However, this index has its limitations. One is that it does not distinguish the agreement on positive ratings (both raters code Yes) from the agreement on negative ratings (both raters code No). Thus, the raw agreement index can only provide very limited information for the researchers. Although much neglected by the literature, the raw agreement index is still an important descriptive statistic for reference.

2. Cohen's *Kappa* Statistic

A commonly-used statistical measure of inter-rater reliability is Cohen's *kappa*. The *kappa* statistic takes into account the fact that raters may sometimes agree or disagree simply by chance. The *kappa* statistic could range from -1.0 to 1.0 (negative numbers are rare), where a *kappa* of 1 means perfect agreement, and a *kappa* of 0 means

agreement equivalent to chance. In general, larger numbers mean better reliability of the data, and numbers near zero indicate that agreement is attributable to chance alone (Elliot & Woodward, 2007).

Note that a caveat of judging inter-rater agreement by Cohen's *kappa* statistic is that Cohen's *kappa* is highly dependent on the prevalence of the finding in the population (Chen, Faris, Hemmelgarn, Walker, and Quan, 2009; Viera & Garrett, 2005). A *prevalence-adjusted bias-adjusted kappa* (PABAK) was then developed (Byrt, Bishop, & Carlin, 1993). The purpose of the PABAK statistic is to account for systematic differences between data sources and the distribution of each observed item (Chen et al. 2009). To be specific, a researcher should address which *kappa* variant is computed. The researcher may consider reporting Byrt et al.'s (1983) prevalence-adjusted *kappa* or Siegel and Castellan's (1988) bias-adjusted *kappa* if either of the prevalence or bias problems is strong (Di Eugenio & Glass, 2004). This dissertation uses SPSS program, and by default it computes Siegel and Castellan's bias-adjusted *kappa* (Yaffee, 2003).

Studies often cite Landis and Koch's (1977) guidelines to interpret *kappa* values. Values from 0.0 to 0.2 indicate slight agreement, 0.21 to 0.40 indicate fair agreement, 0.41 to 0.60 indicate moderate agreement, 0.61 to 0.80 indicate substantial agreement, and 0.81 to 1.0 indicate almost perfect or perfect agreement. However, these cutoffs are sometimes debated. For example, Krippendorff (1980) provides a more conservative interpretation suggesting that variables with *kappa* values less than 0.67 should be discounted, variables with *kappa* values between 0.67 and 0.80 are tentative, and variables with *kappa* values above 0.80 can be definitely kept. In practice, however, *kappa* coefficients below Krippendorff's conservative cutoff values are often retained in

research studies, and Landis and Koch's (1977) guidelines are applied relatively more often (Hallgren, 2012).

3. Intra-Class Correlation Coefficient

Another commonly-used measure is the intra-class correlation (ICC). The intra-class correlation coefficient assesses rating reliability by comparing the variability of different ratings of the same observation to the total variation across all ratings and all observations. It can also be understood as the proportion of the total variance within the data that is explained by the variance between raters (Shrout & Fleiss, 1979). Most often, the value of the ICC ranges from 0 to 1, where as the ICC approaches 1 then there is a perfect agreement between the raters, and as the ICC approaches 0 there is no agreement between the raters.

There are a number of different versions of the ICC that could give quite different results to the same data, and each version is appropriate for specific situations defined by the design of the study. In this dissertation, the "two-way mixed effect model" is selected. It specifies that rater effects are random and measures effects are fixed. The intra-class correlation is also carried out by the SPSS program in this dissertation.

The minimum acceptable values of an intra-class correlation coefficient have also been debated (Van Ness, Towle, & Juthani-Mehta, 2008). Fleiss (1986, p.7) describes values from 0.40 to 0.75 as "fair to good." Streiner and Norman (1995) recommend values greater than 0.75 for continuous scales used in health research. Flack and colleagues (1988) and Walter and colleagues (1998) prepared sample size formulae for the *kappa* and intra-class correlation coefficients, so that reliability studies can be correctly powered (see Van Ness, Towle, & Juthani-Mehta, 2008).

4. Data Collecting Process

In order to control the reliability of the physical environment data (the Google Street View data), a GSV rater was recruited several months after this dissertation began. The rater was employed in the Crime Analysis Unit of Newark Police Department. At the beginning of the process, the rater received specific instructions on how to fill in the GSV data coding instrument (see Appendix). During orientation, the rater raised several concerns regarding the definitions of the variable measure, which helped modify the wording of the coding instrument. The rater also received instruction on the specifics of the Google Maps interface and how to use the pegman, shown as a standard yellow icon, to maneuver the observations.

The rater independently implemented the GSV coding instrument in a stratified random sample of five high-dealing intersections, five dealing-free intersections, and five intersections with some dealing activities from the total street unit pool. The 15 intersections were given to the rater in an aggregated sample set, so that the rater could not have prior assumptions regarding the location being observed (i.e. tending to find more dealing-related factors with the knowledge that it is a high-dealing segment), and so the rater's coding in the GSV coding instrument is less likely to be subject to bias due to assumption. The rater and the author then made independent observations of these 15 street units, and the inter-rater reliability was examined when the observation process was completed. This step is performed to cross-check that the rater and the author are implementing GSV observations in the most reliable way possible.

However, when this step was complete, the inter-rater reliability showed very low levels of agreement. A follow-up meeting discovered that this rater had strong prior

knowledge of the streets in Newark, and that she had coded subjectively based on her memories and experiences. It was then decided to recruit another GSV rater.

The new rater is a doctoral student at the School of Criminal Justice at the Rutgers University-Newark. The rater was also given specific instructions on how to fill in the GSV data coding instrument (see Appendix). During the orientation, the rater raised several questions regarding the specific definitions of the variable measure, and helped further modify the wording of the coding instrument. The rater then received instruction on the specifics of the Google Maps interface and how to use the pegman, shown as a standard yellow icon, to maneuver the observations.

The new rater then independently implemented the GSV coding instrument in a stratified random sample of 30 high-dealing and dealing-free intersections, 30 high dealing and dealing-free street segments. The total 60 street units were given to this rater in an aggregated sample set, so that the rater could not have prior assumptions regarding the location being observed (i.e. tending to find more dealing-related factors with the knowledge that it is a high-dealing segment), and so the rater's coding in the GSV coding instrument is less likely to be subject to bias due to assumption.

This rater and author then made independent GSV observations on these 60 street units. The inter-rater reliability was assessed to ascertain the reliability and accountability of the GSV data before further analysis could proceed (see tables 5 and 6).

5. Results

The data presented in Table 5 and 6 demonstrate that most of the virtual observations are within high levels of agreement (*kappa* and ICC ≥ 0.6) between the raters, except for *cemeteries* and *front stoops*.

Table 6 *Inter-rater Agreement for the Situational Variables - Street Segment (N = 30)* [7]

Variable	# Observed		Raw Agreement (%)[8]	Cohen's *Kappa* Coefficient	Intra-class Correlation Coefficient	Level of Inter-rater Agreement
	Rater 1 (N)	Rater 2 (N)				
Abandoned Building	19	18	96.67	0.93**	0.93**	High
Bus Stop	5	5	93.33	0.76**	0.76**	High
Parking Lot	10	9	90.00	0.77**	0.77**	High
Vacant Land	15	14	96.67	0.93**	0.94**	High
Public Facility	3	5	93.33	0.71**	0.73**	High
Cemetery+	0	1	96.67	N/A	N/A	N/A
Retail Store	6	5	96.67	0.89**	0.89**	High
Front Stoops	25	8	43.33	0.14	0.27	Low
Mailbox	3	1	93.33	0.47*	0.49*	Fair
Church	8	4	86.67	0.60**	0.63**	Moderate

** Significant at level $p < 0.001$, one-tailed hypothesis
* Significant at level $p < 0.05$, one-tailed hypothesis
+ No statistics are computed because one of the variables is a constant; one rater codes all subjects zero.

In Table 5, the results suggest that, on street segments, virtual observations of *abandoned buildings (kappa* = 0.930 and ICC = 0.932)*, bus stops* (*kappa* = 0.760 and ICC = 0.760)*, parking lots* (*kappa* = 0.769 and ICC = 0.771)*, vacant land* (*kappa* = 0.933 and ICC = 0.935)*, public facilities* (*kappa* = 0.714 and ICC = 0.728) *and retail facilities* (*kappa* = 0.889 and ICC = 0.892) have high levels of agreement between raters. These are the well-defined objects that can be clearly identified while hovering around the street images; thus there is only slight disagreement on a few case-control pairs between the raters. Churches, however, have only moderate level of agreement. The recruited rater

[7] The statistics in this Table are computed by SPSS; SPSS only computes the biased-adjusted kappa statistic (Yaffee, 2003).
[8] Proportion of overall agreement between two raters.

counted fewer churches than the author did. It is possible that the author has a broader definition of this variable, while the recruited rater has a narrower definition (only the larger churches which provide mass, service times, etc., and not other religious-based centers and organizations).

Table 7 *Inter-rater Agreement for the Situational Variables - Intersection (N = 29)* [9]

Variable	# Observed		Raw Agreement (%)	Cohen's *Kappa* Coefficient	Intra-class Correlation Coefficient	Level of Inter-rater Agreement
	Rater 1 (N)	Rater 2 (N)				
Abandoned Building	8	11	82.76	0.61**	0.63**	Moderate
Bus Stop	2	3	96.55	0.78**	0.79**	High
Parking Lot	12	11	93.10	0.85**	0.85**	High
Vacant Land	8	8	93.10	0.83**	0.83**	High
Public Facility	2	3	96.55	0.78**	0.79**	High
Cemetery+	0	0	100.00	N/A	N/A	N/A
Retail Store	11	12	96.55	0.93**	0.93**	High
Front Stoops	8	5	75.86	0.32	0.33	Low
Mailbox	3	2	96.55	0.78**	0.79**	High
Church	6	5	96.55	0.89**	0.89**	High

** Significant at level $p < 0.001$, one-tailed hypothesis
+ No statistics are computed because both variables are constants, because both raters code all subjects zero.

In Table 6, the results suggest that, on intersections, virtual observations of *bus stops* (*kappa* = 0.782 and ICC = 0.788)*, parking lots* (*kappa* = 0.854 and ICC = 0.854)*, vacant land* (*kappa* = 0.827 and ICC = 0.827)*, public facilities* (*kappa* = 0.782 and ICC = 0.788), *retail facilities* (*kappa* = 0.928 and ICC = 0.930), and *churches* (*kappa* = 0.888 and ICC = 0.891) have high levels of agreement between raters, and *abandoned buildings*

[9] One case is deleted pair-wise. A rater did not code one intersection from the control sample.

(kappa = 0.613 and ICC = 0.628) have a moderate level of agreement.

From both the Tables 4 and 5, the variables *front stoops* and *cemetery* have very low levels of agreement between the raters. Cemeteries are relatively rare in the sampled locations, thus the inter-rater reliability check does not yield meaningful results. Front stoops, on the other hand, are poorly defined; it was not clear whether this variable included the stoops in front of rental apartment buildings, or in front of both rental apartment buildings and single residential homes. Because of this weakness, there exists significant disagreement in many case-control pairs. As a result, these two variables – *front stoops* and *cemetery* – are dropped from the further analysis.

Variables

Dependent Variable

The dissertation examines the situational factors that account for why certain locations are high-dealing locations while others are not. Active drug dealing locations are geographically clustered in a few locations in Newark. Thus, drug markets are considered a rare event in relation to an area. To understand rare events, a case control equation is applied to sample data for the dependent variable – the presence of a drug market or not (1 or 0). The dependent variable is operationalized as a dichotomous dependent variable: whether the location is actively used for drug dealing or not.

Independent Variables

The number of independent variables examined in this dissertation needs to take into consideration the relatively-small sample size, 135 pairs of case and control street units. After the literature reviews, several field observations in Newark, and the inter-rater reliability checks that ensure the feasibility of the GSV observational data, several

independent variables of interest which were included in the initial dissertation plan are then dropped from the further analysis. Table 7 below provides a summary.

Table 8 *Results of the Process Undertaken to Determine Variables for Further Analysis*

Total Situational Variables of Interest	**Dropped Variable After Field Observation**	**Dropped Variable After Reliability Check**	**Variable Modified by Incorporating Other Variables**	**Remaining Variable For Analysis**
1. *Abandoned Building*				Yes
2. *Security Grille*		Yes		
3. *Bus Stop*				Yes
4. *Parking Lot*				Yes
5. *Vacant Land*				Yes
6. *Cemetery*		Yes		
7. *Public Park*			Yes	Yes
8. *Retail Facility*			Yes	Yes
9. *Front Stoops*		Yes		
10. *Retaining Wall*		Yes		
11. *Mailbox*				Yes
12. *Public Phone*	Yes			
13. *Church*				Yes

Public phone is dropped. The author was advised by a Newark narcotics unit officer that public phones are rarely found in Newark now, and the drug offenders no longer use them as part of their drug operations. *Security grille* is dropped, because it is seen on almost every household in both case and control groups, which makes it impossible to differentiate cases and controls. *Cemetery* is dropped, because it is rarely found in Newark (see Tables 5 and 6). *Retaining wall* is dropped for the same reason.

Front stoops is dropped, because the definition of this variable on the data coding instrument is unclear and the inter-rater observation agreement is very low. Playgrounds and basketball courts are often seen inside or next to public parks, therefore the two factors are incorporated into *public park*. The variable *retail facilities* also includes business-related facilities such as the convenience store, grocery store, liquor store, bar, take-out restaurant (such as Chinese food delivery, fried chicken restaurant), pawnshop, barbershop, and nail salon. In sum, eight variables remain for further analysis.

The final list of variables is categorized into three types, namely (1) the guardianship factor (i.e. presence or lack of guardianship): *abandoned buildings*, *vacant land*, *public parks,* and *churches*; (2) the accessibility factor (i.e. easy access and escape): *bus stops* and *highways,* and (3) the crime generator factor: *parking lots*, and *retail business-related stores*. The variables of interest are listed in Table 8, and will be used as the independent variables to assess their correlation with the occurrence of street dealing in Newark.

Table 9 *Descriptions of the Independent Variables*

Theoretical Perspective and Situational Factors	**Description**
Guardianship Factors (Routine Activity Theory)	
• Abandoned Building	Dichotomous variable, representing whether the street unit has any abandoned building
• Public Park	Dichotomous variable, representing whether there is any public park, playground or basketball court attached to the street unit (yes/no)
• Vacant Land	Dichotomous variable, representing whether there is any vacant land attached to the street unit (yes/no)
• Church	Dichotomous variable, representing whether there is any church attached to the street unit (yes/no)
Accessibility Factors (Rational Choice Perspective)	
• Highway	Dichotomous variable, representing whether the street unit is within 3-block radius (1,114 feet) of a highway exit.
• Bus Stop	Dichotomous variable, representing whether there is any bus stop attached to the street unit (yes/no)
Crime Generator Factors (Crime Pattern Theory)	
• Parking Lot	Dichotomous variable, representing whether there is any parking lot attached to the street unit (yes/no)
• Retail Business-Related Facility	Dichotomous variable, representing whether there is any retail business-related facility (e.g. take-out restaurant, pawn shop, or convenience store) attached to the street unit (yes/no)
• Mailbox	Dichotomous variable, representing whether there is any mailbox attached to the street unit (yes/no)

Summary of the Chapter

This chapter discusses the research method employed to analyze the drug market problem in Newark, NJ. The chapter explains the reasons behind using a matched case-control design and examining the micro-level units of analysis, street segments and intersections. The chapter addresses the process of data collection and sampling; the

chapter also addresses the difficulties during GSV data collection, and challenges faced during case-control sampling. The chapter also addresses the necessary step to recruit a second rater to independently collect GSV data. Inter-rater reliability is evaluated using multiple statistical methods to ensure valid conclusions. Eight variables having moderate-to-high levels of inter-rater agreement are retained for further analysis in the next chapter (*abandoned building, vacant land, public park, church, bus stop, highway, parking lot, and retail store*), while a few variables are excluded (*cemetery*, *front stoops, exterior wall,* and *public phone).* Lastly, the remaining variables are defined and examined in preparation for the next chapter.

CHAPTER 7: ANALYTICAL PROCEDURE AND RESULTS

This chapter first presents the descriptive statistics of the variables. This chapter then constructs bivariate analyses to examine correlations between situational factors examined and the presence (or absence) of street drug markets at the sampled street segments and intersections, using McNemar's test. Then the chapter sets forth a multivariate model to analyze the observed GSV data on street segments, using the conditional logistic regression. These analyses assess the hypothesis that each situational factor is significantly related to the presence (or absence) of a street drug market. The findings will indicate the utility of employing these situational factors in predicting drug activity in Newark for research and policy purposes.

Descriptive Statistics of the Variables

This section demonstrates the data distribution in the street segment dataset and intersection dataset. Table 9 shows that there are 208 streets (104 pairs) included in the dependent variable; half of the 208 streets present a drug market and the other half do not (Mean = 0.5). For the situational variables, because some of the streets are not observable on Google Street Views, so the available observations are decreased to 195 streets (97 pairs, for pair-wise analysis), and these streets are used to collect situational data (from variables 1 to 8). For example, about half of the 208 streets have abandoned buildings (Mean = 0.51) and vacant land (Mean = 0.53). About one-third of the 208 streets have parking lots (Mean = 0.30) and retail facilities (Mean = 0.37). The geographic variables are collected directly from the Newark Street map data, where the total 208 streets (104 pairs) provide information, for example, about one-fifth of the 208 streets are near a highway (Mean = 0.20).

Table 10 *Descriptive Statistics of Street Segment Data*

Variable # and Name	Observation (N)	Pair	Mean	Standard Deviation
Dependent Variable				
Presence of a Drug Market	208	104	0.50	0.50
Situational Variable				
• Abandoned Building	195	97	0.51	0 .50
• Bus Stop	195	97	0.15	0.36
• Parking Lot	195	97	0.30	0.46
• Vacant Land	195	97	0.53	0.50
• Public Park	195	97	0.24	0.43
• Retail Facility	195	97	0.37	0.48
• Mailbox	195	97	0.11	0.32
• Church	195	97	0.24	0.43
Geographic Variable				
• Highway	208	104	0.20	0.40
• One Way	208	104	0.40	0.49

Table 11 *Descriptive Statistics of Intersection Data*

Variable # and Name	Observation (N)	Pair	Mean	Standard Deviation
Dependent Variable				
Presence of a Drug Market	62	31	0.50	0.50
Situational Variable				
5. Abandoned Building	62	31	0.35	0.48
6. Bus Stop	62	31	0.16	0.37
7. Parking Lot	62	31	0.37	0.49
8. Vacant Land	62	31	0.39	0.49
9. Public Park	62	31	0.11	0.32
10. Retail Facility	62	31	0.45	0.50
11. Mailbox	62	31	0.10	0.30
12. Church	62	31	0.27	0.45
Geographic Variable				
13. Highway	62	31	0.06	0.25

Table 10 shows that there are 62 intersections (31 pairs); half of the 62 streets present a drug market and the other half do not (Mean = 0.5). These streets are used to collect situational data (from variables 1 to 8). For example, about one-third of the 62 intersections have abandoned buildings (Mean = 0.35), parking lots (Mean = 0.37) and

vacant land (Mean = 0.39). Almost half of the 62 intersections have retail facilities (Mean = 0.45). The geographic variables are collected directly from the Newark Street map data; very few of the 62 intersections are near a highway (Mean = 0.06).

Bivariate Analysis: Difference in Case and Control Samples on the Presence of Situational Factor

This section demonstrates the structure of the bivariate analysis, and the nonparametric test carried out for the matched pair dataset. The bivariate analyses examine the hypothesis that each of the situational variables is related to the dependent variable (whether there is a drug market or not).

For categorical data involving independent samples, a chi-square test is commonly employed. A chi-square test is often used in two types of hypothesis: (1) evaluating whether or not the *r* samples are homogeneous with respect to the proportion of the subjects in each of the *c* categories, and (2) evaluating the general hypothesis of independence (no correlation) between two independent samples (Sheskin, 2003, pp.493-495). However, in the present study, the subjects in the case and control groups are not independently sampled. Rather, they are related on several confounding factors. In this situation, it can be seen as a pre-post design, and the interest is directed toward the *change* from the pre-group to post-group (Runyon, 1977). For categorical data involving "related" samples, there is a form of the chi-square test for within-subjects designs called McNemar's test, which will be employed for testing the bivariate relationships in this dissertation. McNemar's test can be seen as a paired version of the chi-square test, which is introduced below.

1. Introduction to McNemar's Test

The McNemar's test is commonly used to evaluate categorical data obtained in a true experiment, i.e. an experiment involving an independent variable manipulated by the researcher. In this type of experiment, the two scores of each subject (or *n* pairs of matched subjects) represent a subject's responses to the two categories of the independent variable, i.e. the experimental conditions such as yes or no, success or failure. Thus, a significant result allows the researcher to conclude that there is a high likelihood the two categories of the independent variable represent two separate populations (Sheskin, 2003). The McNemar's test is also commonly used to evaluate a one-group pre-test/post-test design. The hypothesis evaluated with this type of design is whether or not there is a significant difference between the pre-test and post-test scores of subjects on the dependent variable (Sheskin, 2003).

McNemar's test is a non-parametric procedure for categorical data used in a hypothesis-testing situation when the design has two dependent samples (McNemar, 1947). The McNemar's test is also a special case of the more commonly seen test, the Cochran Q test, which is used to evaluate a *k*-dependent samples design with categorical data, where $k >= 2$. The McNemar's test is used when evaluating an experiment in which a sample of *n* subjects (or *n* pairs of matched subjects) is analyzed on a dichotomous dependent variable, i.e. value on the dependent variable must fall within one of two mutually exclusive categories (Sheskin, 2003). It is employed for assessing the difference of proportions on matched pairs of two related samples (Black, 1999). In this study, the McNemar's test is used to assess whether or not a particular situational factor has a significantly disproportionate presence on high-dealing locations versus on dealing-free

locations.

The present dissertation is interested in comparing the *difference* of a variable effect between a case and its matched control. The McNemar's test is a non-parametric test which allows testing two dependent samples (Sheskin, 2003), which can be employed to test difference of proportion on matched pairs of two related samples. This test is commonly used to look for the significance of change between categories of subjects due to the experimental treatment (Runyon, 1977, p.56; Black, 1999, p.596). In other words, the test is to detect the subjects who changed before and after implementing the treatment; and whether the number of the observations who received the treatment was significantly changed before and after the experiment.

A McNemar's test model is generally depicted in the following 2 x 2 Table:

		After/ Post-test/Case	
		No/Not Exposed	Yes/Exposed
Before/ Pre-test/Control	Yes/Exposed	**a**	**b**
	No/Not Exposed	**c**	**d**

Table 12 *McNemar's Test*

Cells *a* and *d* represent before-after changes: cell *a* from Yes to No, cell *d* from No to Yes. These are the two cells upon which the McNemar's test focuses (Runyon, 1977). The typical non-directional (two-tailed) null hypothesis is that the population proportion of those who change from No to Yes is the same as the proportion who change from Yes to No. Thus, the McNemar's test is meant to detect if there is a statistically significant difference (change) between **a** and **d**.

2. Results and Interpretations

(1) Street segment data

There are 104 pairs of case-control street segments in this dataset, matched by there street length and the geographic distance. These case and control streets are compared and analyzed by the McNemar's chi-square test as the following Table 12.

Table 13 *Difference in Case and Control Street Segments on the Presence of Situational Factor (N = 97)*

Variables	**Control N (%)**	**Case N (%)**	***Power***
Abandoned Building**	38 (39.2)	61 (62.9)	0.95
Bus Stop*	8 (08.2)	22 (22.7)	0.85
Parking Lot**	19 (19.6)	39 (40.2)	0.97
Vacant Land*	46 (47.4)	57 (58.8)	0.61
Public Park	24 (24.7)	23 (23.7)	0.34
Retail Facility*	30 (30.9)	41 (42.3)	0.56
Mailbox	8 (08.2)	14 (14.4)	0.41
Church*	32 (33.0)	15 (15.5)	0.88

McNemar's chi-square test: ** Significant at level $p < 0.001$, one-tailed hypothesis
* Significant at level $p < 0.05$, one-tailed hypothesis

Table 12 shows the results of the McNemar's test. The McNemar's test here tells whether or not the prevalence of a situational factor on the case streets is strongly different from that on the control streets. As the Table shows, the McNemar's test is significant at a 95% confidence interval for the bus stop, vacant land, retail facility, and church. Also, the McNemar's test is significant at a 99% confidence interval for the abandoned building and parking lot. These results suggest that there is a statistically significant difference between the prevalence of these situational factors on the case streets and on the corresponding control addresses. According to the Table 12, there were

significantly more abandoned buildings found on the case streets (N = 61) than on the control streets (N = 38). There were significantly more bus stops found on the case streets (N = 22) than on the control streets (N = 8). There were significantly more parking lots found on the case streets (N = 39) than on the control streets (N = 19). There was significantly more vacant land found on the case streets (N = 57) than on the control streets (N = 46). Also, there were significantly more business-related retail facilities found on the case streets (N = 41) than on the control streets (N = 30). These results suggest that we can find significant differences between cases and controls on the basis of these five situational factors. Also, as hypothesized, we can find significant differences between cases and controls based on the presence of churches. According to the Table 12, there were significantly more churches found on the control streets (N = 32) than on the case streets (N = 15), which implies that churches act as guardians that suppress drug-dealing activity in the vicinity.

(2) Intersection data

There are 31 pairs of case-control intersections in this dataset, matched by their intersecting major thoroughfares and distance. These case and control intersections are compared and analyzed by the McNemar's chi-square test as the following Table 13.

The McNemar's test here examines whether or not the prevalence of a situational factor on the case intersections is strongly different from that on the control intersections. As the Table shows, the McNemar's test is significant at a 95% confidence interval only for the retail facility. The result suggests that there is a statistically significant difference between the prevalence of business-related retail facilities on the case intersections and on the corresponding control intersections. According to Table 13, there were

significantly more business-related retail facilities found on the case intersections (N = 19) than on the control intersections (N = 9). These results suggest that we can find significant differences between cases and controls based on the presence of retail facilities. That is the only situational factor found to present significantly different in cases and controls.

Table 14 *Difference in Case and Control Intersections on the Presence of Situational Factor (N = 31)*

Variable	**Control N (%)**	**Case N (%)**	***Power***
Abandoned Building	10 (32.3)	12 (38.7)	0.16
Bus Stop	4 (12.9)	6 (19.4)	0.17
Parking Lot	13 (41.9)	10 (32.3)	0.19
Vacant Land	11 (35.5)	13 (41.9)	0.16
Public Park	4 (12.9)	3 (09.7)	0.10
Retail Facility*	9 (29.0)	19 (61.3)	0.83
Mailbox	2 (06.5)	4 (12.9)	0.26
Church	7 (22.6)	10 (32.3)	0.21

McNemar's chi-square test: * Significant at level $p < 0.05$, one-tailed hypothesis

However, it is critical to note that the statistical powers for the McNemar's tests are low, except for the variable retail facility (power = 0.83). The low statistical powers indicate that no strong statistical inference can be made on those variables. Any interpretation of the results must be viewed with caution.

Multivariate Analysis: Assessing the Causal Inferences between the Situational Factors and Street Drug Market

In this section, conditional logistic regression is used to analyze which situational factors can explain the presence of a street drug market on the sampled locations. In

addition to the results found in the bivariate relationships in the last section (Bivariate Analysis: Difference in Case and Control Samples on the Presence of Situational Factor), where some situational factors were found individually to be significantly related to the presence of street drug markets, this section uses conditional logistic regression to incorporate all the situational variables into a model and examine them altogether. Instead of examining the intersection data itself, the multivariate model examines a pooled data combining street segment and intersection datasets.

1. Introduction to Conditional Logistic Regression

(1) Regression model for binary outcomes and odds ratio

When the dependent variable is dichotomous and the researcher wishes to measure the effects of several independent variables on it, the most proper method of analysis to use is Logistic Regression. The dependent variable is coded 0 and 1, where 0 is conventionally associated with fail or no and 1 is associated with success or yes.

In a multiple linear regression, the basic activity is to draw the least square line around which the values of Y (the dependent variable) are distributed. Contrarily, in logistic regression the fundamental activity is to estimate the *probability* that a given subject will fall into one outcome category or the other (Ebrahim, G. J., Simkiss, D. D., & Watershorn, 2013). Therefore, as a measure of the probability, a logistic regression yields the odds of an event occurring. Assume that P is the probability of a given event, and (1-P) is the probability of the event not occurring; then the odd of the event is defined as:

$$\text{Odds} = P / 1 - P,$$

in other words, $P / 1 - P$ is the ratio of the probability of success for one factor. Similarly, if there are several factors involved in deciding the outcome (the dependent variable), the

odds ratio can be calculated for each one separately. The "joint effect" of all the independent factors put together can be expressed as:

$$\text{Odds} = P / (1 - P) = e^{\alpha+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta pXp},$$

and the independent effect of each of several factors to the overall odds ratio can be calculated by taking the logarithms of both sides of the previous equation:

$$\log_e \{P / (1 - P)\} = \log_e e^{\alpha+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta pXp},$$

thus, the natural logarithm of P / (1 – P), written as the logit (P), becomes:

$$\text{logit}(P) = \alpha+\beta 1X1+\beta 2X2+\beta 3X3+\ldots+\beta pXp,$$

which is very similar to the form of a multiple linear regression. Supposing there is one unit change in X1, it will increase the log odds by an amount of $\beta 1$. In other words, the odds themselves are increased by a factor of e^{β} (Ebrahim, G. J., Simkiss, D. D., & Watershorn, 2013).

In addition, in a multiple linear regression, the parameters of the model are estimated using the *least squares,* meaning that the coefficients selected are such that the sums of squared distances from the observed values to the predicted values (the regression line) are the smallest. In logistic regression, the parameters are estimated such that the coefficients make the "observed" outcomes most likely. This method is called the *maximum likelihood* method.

(2) Conditional logistic regression

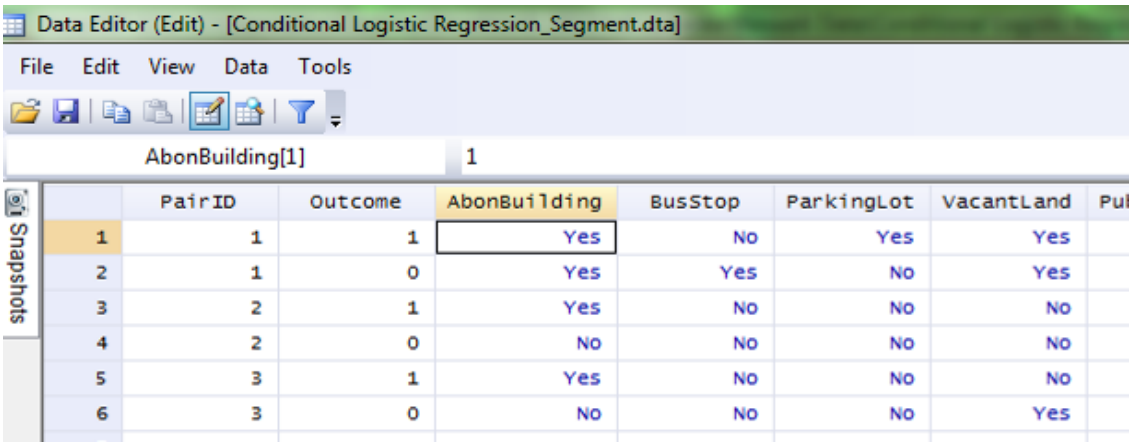
The above discussed unconditional logistic regression is preferred when the number of parameters is small relative to the number of subjects. Otherwise, for example, in a case-control study of 100 matched pairs, i.e. the number of subjects is 200, there will be 99 dummy variables created to represent each pair. Added to the equation are the

intercept and the risk factors of interest. Thus, the total number of parameters would exceed 101. A conditional logistic regression can simplify this situation. In general, a conditional logistic regression is used when matching has been done, compared to an unconditional one if there has been no matching. Also, conditional regression is preferred because it always gives unbiased results. The unconditional method is found to often overestimate the odds ratio if it is not applied appropriately (Ebrahim, G. J., Simkiss, D. D., & Watershorn, 2013).

The conditional logistic regression may be seen as an extension of the McNemar's test to examine the relationship between a dichotomous dependent variable and a set of independent variables in matched case-control studies (Hosmer & Lemeshow, 2000), taking into account the possible confounding effects of one or more variables. Conditional logistic regression does not assume that observations are independent since its main application is that observations are matched (or grouped) in some way. When matched pairs are included in the model, the unit of observation in each matched pair is no longer two independent subjects but rather the *difference* between the two subjects within each pair (Menard, 2010, pp. 245-246).

In this study, conditional logistic regression is used to evaluate the significance of various situational factors which may possibly indicate the presence (or absence) of street drug markets in the selected locations in Newark. The conditional logistic regression model is carried out in the STATA software through the *Conditional Logistic Regression* function. The setup of the data file for a matched case-control study through conditional logistic regression is designed in the following way:

1. The first column represents the pair ID, and every two rows correspond to a matched pair.
2. The second column, the dependent variable, correspondingly shows two values – 1 (case) and 0 (control).
3. Other columns show *variable 1*, *variable 2*, and so on.



	PairID	Outcome	AbonBuilding	BusStop	ParkingLot	VacantLand	Pul
1	1	1	Yes	No	Yes	Yes	
2	1	0	Yes	Yes	No	Yes	
3	2	1	Yes	No	No	No	
4	2	0	No	No	No	No	
5	3	1	Yes	No	No	No	
6	3	0	No	No	No	Yes	

Figure 21 Setup of the matched case-control data file

2. Model Diagnostics, Results and Interpretations

Multivariate models illustrated below examine the association between each situational variable and the presence of street drug market. Note that this section only analyzes the street segment data, and not the intersection data due to its small sample size (N = 31 pairs) and the relatively large degree of freedom (there are eight situational variables, so the d.f. = 7). The construction process of the model and the diagnostics will be illustrated first, and then the decisions will be discussed.

(1) Street segment data

Model 1 includes all the situational factors while Model 2 includes all the situational factors plus the geographic variables *highway* (whether the sampled street is within 1114 ft of a highway exit) and *one-way* (whether the sampled street is a one-way

street). These two additional variables are not situational factors that are of interest, but are suspected to be affecting the chance of having a street drug market. Model 3, on the other hand, adds the interaction term, *retail facility * vacant land*, and thus lets the model take account of the differences between having vacant land nearby or not with respect to having a retail facility on the presence of local drug markets (see Evans & Oulds, 1984, Herbert, 1982, and Duffala, 1976, and a brief discussion in Chapter 4, p. 40, about the relationship of crime to the presence of retail stores near vacant lands).

In order to make the results of the conditional logistic regression model more meaningful, the conditional odds ratio (OR) is reported instead of the logistic regression coefficients. The odds ratio represents the odds of observing cases (e.g., streets with frequent drug activities) that are exposed to risk (situational) factors, over the odds of observing controls (e.g., streets free of drug activities) that are exposed to the same factors for each pair of case-control.

According to Table 14 and Table 15, the -2 Log Likelihood of Model 1 is 97.146 while the -2 Log Likelihood of Model 2 is 95.68566. To evaluate if the improvement from the Model 1 to Model 2 is significant, a likelihood-ratio test is performed by STATA. The results show that the *LR chi2(2)* is 1.46 and the p value is 0.4819, meaning that the adjustment in Model 2 is not significantly improving Model 1.

However, according to Table 16, the -2 Log Likelihood of Model 3 is 91.32278, compared to the -2 Log Likelihood of Model 1 that is 97.146. A likelihood-ratio test is performed, and the result shows that the *LR chi2(1)* is 5.82 and the p value is 0.0158. Adding the interaction term decreases the -2 log likelihood, and the increase in the

Table 15 *Estimated Associations between Situational Factor and Presence of Drug Market on Street Segments, Using Conditional Logistic Regression*

Variable	**Model 1 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.45 (1.15, 5.22)*
Bus Stop	3.39 (1.17, 9.81)*
Parking Lot	3.95 (1.58, 9.92)**
Vacant Land	1.55 (0.63, 3.82)
Public Park	1.62 (0.58, 4.55)
Retail Facility	1.10 (0.45, 2.70)
Mailbox	2.78 (0.81, 9.61)*
Church	0.47 (0.20, 1.11)*
-2 Log Likelihood	**97.15**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
** Significant at level $p < 0.001$, one-tailed hypothesis
-2 Log Likelihood for the "constant-only" model = 134.47

Table 16 *Estimated Associations between Situational Factor, Geographic Factor, and Presence of Drug Market on Street Segments, Using Conditional Logistic Regression*

Variable	**Model 2 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.75 (1.21, 6.27)*
Bus Stop	2.84 (0.97, 8.31)*
Parking Lot	4.12 (1.60, 10.60)**
Vacant Land	1.46 (0.58, 3.64)
Public Park	1.61 (0.56, 4.60)
Retail Facility	1.07 (0.43, 2.66)
Mailbox	2.96 (0.85, 10.34)*
Church	0.47 (0.20, 1.14)*
Geographic Variable	
Highway	0.89 (0.12, 6.54)
One Way	0.64 (0.30, 1.35)
-2 Log Likelihood	**95.69**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
** Significant at level $p < 0.001$, one-tailed hypothesis
-2 Log Likelihood for the "constant-only" model = 134.47

Table 17 *Estimated Associations between Situational Factor, Interaction Effect, and Presence of Drug Market on Street Segments, Using Conditional Logistic Regression*

Variable	**Model 3 OR (95% C.I.)**
Situational Variable	
Abandoned Building	3.04 (1.35, 6.84)*
Bus Stop	4.51 (1.38, 14.73)*
Parking Lot	4.65 (1.76, 12.28)**
Vacant Land	0.75 (0.25, 2.22)
Public Park	2.04 (0.67, 6.22)
Retail Facility	0.36 (0.10, 1.36)
Mailbox	2.68 (0.79, 9.14)*
Church	0.50 (0.20, 1.22)
Interaction Effect	
Retail Facility * Vacant Land	8.33 (1.34, 51.73)*
-2 Log Likelihood	**91.32**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
** Significant at level $p < 0.001$, one-tailed hypothesis
-2 Log Likelihood for the "constant-only" model = 134.47

model's fit is statistically significant. This result suggests that the addition of the interaction term is statistically significant in improving the model.

The significant *p values* of *abandoned buildings, bus stops, parking lots, mailboxes, and churches* found in Model 1 lead to the inference that the associations between these five situational variables and the presence of drug markets are not likely a result of random chance; instead, it is highly likely that these situational factors play a relevant role in creating opportunities for street drug markets. The results show that the odds of finding an abandoned building on a high-dealing street segment is 2.45 times as the odds of finding one on a dealing-free street segment. The odds of finding a bus stop on a high-dealing street segment is 3.389 times as the odds of finding one on a dealing-free street segment. The odds of finding a parking lot on a high-dealing street segment is

3.952 times as the odds of finding one on a dealing-free street segment. The odds of finding a mailbox on a high-dealing street segment is 2.782 times as the odds of finding one on a dealing-free street segment. On the contrary, the odds of finding a church on a dealing-free street segment is 2.151 times (OR = 0.465) as the odds of finding one on a high-dealing street segment. *Vacant land, public park, and retail facility* do not significantly affect the model.

Model 2 inserts two additional variables – *highway* and *one-way*. The results show that the odds of finding an abandoned building on a high-dealing street segment is 2.753 times as the odds of finding one on a dealing-free street segment. The odds of finding a bus stop on a high-dealing street segment is 2.838 times as the odds of finding one on a dealing-free street segment. The odds of finding a parking lot on a high-dealing street segment is 4.122 times as finding one on a dealing-free street segment. The odds of finding a mailbox on a high-dealing street segment is 2.961 times as the odds finding one on a dealing-free street segment. On the contrary, the odds of finding a church on a dealing-free street segment is 2.123 times (OR = 0.471) as the odds of finding one on a high-dealing street segment. However, the results show that the two additional variables are not significant. This result confirms that the chances of drug market occurring in sampled locations in Newark are due to these particular characteristics of these locations rather than its close proximity from the highway or the street patterns (one-way or two-way). *Vacant land, public parks, retail facilities*, and the geography of the location do not significantly affect the model.

Model 3 adds an interaction effect between *retail facilities* and *vacant land* instead. The results show that the odds of finding an abandoned building on a high-

dealing street segment is 3.036 times as the odds of finding one on a dealing-free street segment. The odds of finding a bus stop on a high-dealing street segment is 4.514 times as the odds of finding one on a dealing-free street segment. The odds of finding a parking lot on a high-dealing street segment is 4.646 times as the odds of finding one on a dealing-free street segment. The odds of finding a mailbox on a high-dealing street segment is 2.677 times as the odds finding one on a dealing-free street segment. In addition, the odds of finding a retail facility on a high-dealing street segment, taking into account of having vacant land nearby, is 8.326 times as the odds of finding one on a dealing-free street segment.

Table 18 *Summary of Multivariate Analyses on Street Segment Data*

Variable		**Odds Ratio**		
		Model 1	**Model 2**	**Model 3**
Situational Variable	Abandoned Building	2.45*	2.75*	3.04*
	Bus Stop	3.39*	2.84*	4.51*
	Parking Lot	3.95**	4.12**	4.65**
	Vacant Land	1.55	1.46	0.75
	Public Park	1.62	1.61	2.04
	Retail Facility	1.10	1.07	0.36
	Mail Box	2.78*	2.96*	2.68*
	Church	0.47*	0.47*	0.50
Geographic Variable	Highway		0.89	
	One Way		0.64	
Interaction Effect	Retail Facility * Vacant Land			8.33*
-2 Log Likelihood		**97.15**	**95.69**	**91.32**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
** Significant at level $p < 0.001$, one-tailed hypothesis
-2 Log Likelihood for the "constant-only" model = 134.47

Overall, about half of the situational variables play a significant role in explaining the occurrence of drug markets in sampled street segments. Compare the models 1 to 3

(see Table 17), the variable *parking lot* remains having the larger effect (odds ratios are larger than 4) on predicting the presence of a drug market. *Church*, on the other hand, is often found more on control than case street segments. While *vacant land* and *retail facility*, respectively, do not have significant effects, a retail facility near a vacant land is strongly significantly more likely to be found on cases than control street segments. The results here may be of substantial implication to the design of crime prevention policies incorporating situational influences as relevant crime-reduction strategies for the local drug market issue. Further discussion will be presented in the following chapter.

(2) Pooled data

Because the sample size of the intersection dataset is small (N = 31) in relation to the numbers of independent variable (there are eight situational variables), conducting a multivariate analysis on the intersection data would result in a very low degree of freedom (d.f. = 7). Thus, the street segment and intersection datasets are pooled for the purpose of conducting a multivariate analysis. Model 4 includes all the situational variables while the Model 5 includes all the situational variables plus the geographic variable *highway* (whether the sampled street is within 1114 ft of a highway exit). Again, this additional variable is not a situational factor that is of interest, but is suspected to be affecting the chance of having a street drug market.

A new dichotomous variable, *intersection*, is introduced in Model 6, which indicates whether or not the location is an intersection (1) or a street segment (0). This step allows Model 6 to add the interaction term, *parking lot * intersection*, and thus lets the model take account of the differences between locating on an intersection or not with respect to having a parking lot on the presence of street drug markets. Similarly, Model 7

adds the interaction term, *retail facility * intersection* and Model 8 adds the interaction term, *church * intersection*.

Table 19 *Estimated Associations between Situational Factor and Presence of Drug Market on Street Units, Using Conditional Logistic Regression*

Variable	**Model 4 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.18 (1.16, 4.09)*
Bus Stop	2.60 (1.12, 6.03)*
Parking Lot	1.96 (1.01, 3.78)*
Vacant Land	2.00 (0.95, 4.19)*
Public Park	1.27 (0.56, 2.89)
Retail Facility	2.08 (1.05, 4.14)*
Mailbox	3.83 (1.26, 11.66)*
Church	0.84 (0.43, 1.63)
-2 Log Likelihood	**141.70**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

Table 20 *Estimated Associations between Situational Factor, Geographic Factor, and Presence of Drug Market on Street Units, Using Conditional Logistic Regression*

Variable	**Model 5 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.16 (1.14, 4.08)*
Bus Stop	2.59 (1.12, 6.00)*
Parking Lot	1.95 (1.01, 3.76)*
Vacant Land	1.99 (0.95, 4.18)*
Public Park	1.27 (0.56, 2.89)
Retail Facility	2.09 (1.05, 4.15)*
Mailbox	3.81 (1.25, 11.59)*
Church	0.83 (0.43, 1.63)
Geographic Variable	
Highway	0.82 (0.14, 4.85)
-2 Log Likelihood	**141.65**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

Table 21 *Estimated Associations between Situational Factor and Presence of Drug Market on Street Units, Using Conditional Logistic Regression*

Variable	**Model 6 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.19 (1.13, 4.25)*
Bus Stop	2.81 (1.16, 6.82)*
Parking Lot	3.87 (1.56, 9.63)*
Vacant Land	1.92 (0.90, 4.08)*
Public Park	1.22 (0.52, 2.82)
Retail Facility	2.22 (1.10, 4.49)*
Mailbox	3.28 (1.05, 10.23)*
Church	0.78 (0.40,1.54)
Interaction Effect	
Parking Lot * Intersection	0.16 (0.04, 0.67)*
-2 Log Likelihood	**135.04**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

Table 22 *Estimated Associations between Situational Factor and Presence of Drug Market on Street Units, Using Conditional Logistic Regression*

Variable	**Model 7 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.27 (1.20, 4.30)*
Bus Stop	3.07 (1.30, 7.27)*
Parking Lot	1.92 (0.99, 3.74)*
Vacant Land	1.82 (0.85, 3.91)
Public Park	1.21 (0.52, 2.80)
Retail Facility	1.26 (0.55, 2.90)
Mailbox	3.77 (1.24, 11.44)*
Church	0.76 (0.38, 1.53)
Interaction Effect	
Retail Facility * Intersection	5.09 (0.92, 28.23)*
-2 Log Likelihood	**137.70**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

Table 23 *Estimated Associations between Situational Factor and Presence of Drug Market on Street Units, Using Conditional Logistic Regression*

Variable	**Model 8 OR (95% C.I.)**
Situational Variable	
Abandoned Building	2.16 (1.13, 4.12)*
Bus Stop	2.78 (1.18, 6.55)*
Parking Lot	2.11 (1.08, 4.14)*
Vacant Land	1.80 (0.85, 3.81)
Public Park	1.35 (0.59, 3.11)
Retail Facility	1.96 (0.97, 3.97)*
Mailbox	3.94 (1.26, 12.37)*
Church	0.55 (0.24, 1.24)
Interaction Effect	
Church * Intersection	4.49 (1.00, 20.29)*
-2 Log Likelihood	**137.75**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

According to Table 17 and Table 19, the -2 Log Likelihood of Model 4 is 141.70 while the -2 Log Likelihood of Model 6 is 135.04. Again, to evaluate if the improvement from Model 4 to Model 6 is significant, a likelihood-ratio test is performed through the use of STATA. The results show that the *LR chi2(1)* is 6.66 and the p value is 0.0099. Adding the interaction term decreases the -2 log likelihood, and the increase in the model's fit is statistically significant. This result suggests that the adjustment in Model 6 is statistically significantly improving Model 4.

Furthermore, according to Table 20, the -2 Log Likelihood of Model 7 is 137.70, compared to the -2 Log Likelihood of Model 4 that is 141.70. A likelihood-ratio test is performed, and the result shows that the *LR chi2(1)* is 4.00 and the p value is 0.0455, meaning that the adjustment in Model 7 is statistically significantly improving Model 4. Similarly, according to Table 21, the -2 Log Likelihood of Model 8 is 137.75, compared

to the -2 Log Likelihood of Model 4 that is 141.70. A likelihood-ratio test is performed, and the result shows that the *LR chi2(1)* is 3.94 and the p value is 0.0471, meaning that the adjustment in Model 8 is statistically significantly improving Model 4.

The significant *p* values of *abandoned buildings*, *bus stops*, *parking lots*, *vacant land, retail facilities, and mailboxes*, found in Model 4 lead to the inference that the associations between these six situational variables and the presence of drug markets are not likely a result of random chance; instead, it is highly likely that these situational factors play a relevant role in creating opportunities for street drug markets. The results show that the odds of finding an abandoned building on a high-dealing street unit is 2.18 times the odds of finding one on a dealing-free street unit. The odds of finding a bus stop on a high-dealing street unit is 2.60 times the odds of finding one on a dealing-free street unit. The odds of finding a parking lot on a high-dealing street unit is 1.96 times the odds of finding one on a dealing-free street unit. The odds of finding vacant land on a high-dealing street unit is two times the odds of finding one on a dealing-free street unit. The odds of finding a retail facility on a high-dealing street unit is 2.08 times the odds of finding one on a dealing-free street unit. The odds of finding a mailbox on a high-dealing street unit is 3.83 times the odds of finding one on a dealing-free street unit. *Public park* and *church* do not significantly affect the model.

Model 5 inserts an additional variable – *highway*. The results show that the odds of finding an abandoned building on a high-dealing street unit is 2.16 times the odds of finding one on a dealing-free street unit. The odds of finding a bus stop on a high-dealing street unit is 2.59 times the odds of finding one on a dealing-free street unit. The odds of finding a parking lot on a high-dealing street unit is 1.95 times finding one on a dealing-

free street unit. The odds of finding vacant land on a high-dealing street unit is 1.99 times the odds of finding one on a dealing-free street unit. The odds of finding a retail facility on a high-dealing street unit is 2.09 times the odds of finding one on a dealing-free street unit. The odds of finding a mailbox on a high-dealing street unit is 3.81 times the odds finding one on a dealing-free street unit. However, the result shows that the additional variable, *highway*, is not significant. This result confirms that the chances of drug markets occurring in locations in Newark are due to these particular physical characteristics of these locations rather than their close proximity to a highway. *Public park, church*, and the geography of the location do not significantly affect the model.

Taken together, Models 6, 7, and 8 add the interaction effects – *parking lot * intersection*, *retail facility * intersection*, and *church * intersection*, respectively. The results of Model 6 suggest that the odds of finding an abandoned building on a high-dealing street unit is 2.19 times the odds of finding one on a dealing-free street unit. The odds of finding a bus stop on a high-dealing street unit is 2.81 times the odds of finding one on a dealing-free street unit. The odds of finding a parking lot on a high-dealing street unit is 3.87 times the odds of finding one on a dealing-free street unit. The odds of finding vacant land on a high-dealing street unit is 1.92 times the odds of finding one on a dealing-free street unit. The odds of finding a retail facility on a high-dealing street unit is 2.22 times the odds of finding one on a dealing-free street unit. The odds of finding a mailbox on a high-dealing street unit is 3.28 times the odds of finding one on a dealing-free street unit. Specifically for intersections, the odds of finding a parking lot on a high-dealing intersection is 3.71 (3.87 minus 0.16) times the odds of finding one on a dealing-free intersection.

The results of Model 7 suggest that the odds of finding an abandoned building on a high-dealing street unit is 2.27 times the odds of finding one on a dealing-free street unit. The odds of finding a bus stop on a high-dealing street unit is 3.07 times the odds of finding one on a dealing-free street unit. The odds of finding a parking lot on a high-dealing street unit is 1.92 times the odds of finding one on a dealing-free street unit. The odds of finding a mailbox on a high-dealing street unit is 3.77 times the odds finding one on a dealing-free street unit. Specifically for intersections, the odds of finding a retail facility on a high-dealing intersection is 5.09 times the odds of finding one on a dealing-free intersection.

The results of Model 8 suggest that the odds of finding an abandoned building on a high-dealing street unit is 2.16 times the odds of finding one on a dealing-free street unit. The odds of finding a bus stop on a high-dealing street unit is 2.78 times the odds of finding one on a dealing-free street unit. The odds of finding a parking lot on a high-dealing street unit is 2.11 times the odds of finding one on a dealing-free street unit. The odds of finding a retail facility on a high-dealing street unit is 1.96 times the odds of finding one on a dealing-free street unit. The odds of finding a mailbox on a high-dealing street unit is 3.94 times the odds of finding one on a dealing-free street unit. Interestingly, the odds of finding a church on a high-dealing intersection is 4.49 times the odds of finding one on a dealing-free intersection, which indicates that a church is *more likely* to be associated with street drug markets when it is on an intersection.

Table 24 *Summary of Multivariate Analyses on the Pooled Data*

Variable		Odds Ratio				
		Model 4	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Situational Variable	Abandoned Building	2.18*	2.16*	2.19*	2.27*	2.16*
	Bus Stop	2.60*	2.59*	2.81*	3.07*	2.78*
	Parking Lot	1.96*	1.95*	3.87*	1.92*	2.11*
	Vacant Land	2.00*	1.99*	1.92*	1.82	1.80
	Public Park	1.27	1.27	1.22	1.21	1.35
	Retail Facility	2.08*	2.09*	2.22*	1.26	1.96*
	Mail Box	3.83*	3.81*	3.28*	3.77*	3.94*
	Church	0.84	0.83	0.78	0.76	0.55
Geographic Variable	Highway		0.82			
Interaction Effect	Parking Lot * Intersection			0.16*		
	Retail Facility * Intersection				5.09*	
	Church * Intersection					4.50*
-2 Log Likelihood		**141.70**	**141.65**	**135.04**	**137.70**	**137.75**

OR = Odds Ratio, 95% C.I. = 95% confidence interval
* Significant at level $p < 0.05$, one-tailed hypothesis.
-2 Log Likelihood for the "constant-only" model = 177.45

Overall, about half of the situational variables play a significant role in explaining the occurrence of drug markets in sampled street units. Comparing Models 4 to 8 (see Table 23), the variable *mailbox* is a relatively stronger indicator (odds ratios are close to 4) for explaining the presence of a drug market. In addition, the odds of having retail facilities on drug market intersections are much higher than the odds of having them on drug-free intersections. Notably, the odds of having churches on drug market intersections are found to be much higher than the odds of having them on drug-free intersections. This indicates that, on intersections, churches are associated with more drug dealing activities, which is the opposite of what the hypothesis proposed. The main difference in the results from the street segment data and pooled data is that churches on intersections are associated with more drug dealing activities while churches on street

segments are associated with less drug dealing activities. In other words, churches are negative indicators (guardians) on street segments but positive indicators (crime generators) on intersections. The results here may be of substantial implication to the design of crime prevention policies incorporating situational influences as relevant crime-reduction strategies for the local drug market issue. Further discussion will be presented in the following chapter.

Summary of the Chapter

Both qualitative and quantitative research has indicated that drug dealers tend to sell drugs at certain locations. For bivariate analyses, this chapter employs the McNemar's test to examine each situational factor and its correlation to the presence of the local drug market individually, and determine which factor distinguish drug-dealing locations from dealing-free locations. For multivariate analyses, this chapter employs the conditional logistic regression to explain the causal relationships between the situational factors and street drug markets. From the bivariate analyses, the findings suggest that the prevalence of abandoned buildings, bus stops, parking lots, vacant land, retail facilities and churches on the case streets, respectively, is significantly different from their prevalence on the corresponding control streets. On the other hand, the results only indicate the prevalence of retail facilities on the case intersections to be significantly different from their prevalence on the corresponding control intersections. From the multivariate analyses, the results suggest that abandoned buildings, bus stops, parking lots, mailboxes, and retail facilities (near vacant land) can strongly explain the presence of drug markets on street segments. Churches on street segments, on the other hand, prevent the occurrence of drug markets. The results also suggest that parking lots, retail

facilities, and churches can strongly explain the presence of drug markets on intersections. Particularly on intersections, the presence of churches is found to be a crime generator that is associated with the occurrence of local drug markets. The geographic factors – the proximity to the highway and being located on a one-way street – do not significantly influence the presence of a local drug market.

CHAPTER 8: SUMMARY, DISCUSSIONS, AND CONCLUSIONS

This chapter first offers a summary of the statistical findings from the last chapter. This chapter then incorporates a discussion section where it addresses (1) the major differences detected from the street segment model and intersection model, which is a critical contribution this dissertation makes; (2) the powerful influences of risk factors and protective factors in relation to the drug market locations; (3) the importance of each environmental theory used, respectively, and implications for future theoretical studies; and (4) several methodological limitations of this study, such as issues encountered during the development of the research design, concerns regarding the sampling process, and the application of Google Street View. This chapter concludes the dissertation by addressing promising implications for policy and future research.

Summary of the Findings

In Chapter 5, it is hypothesized that (1) street drug dealing happens at locations lacking capable guardians, (2) street drug dealing happens at locations connecting with an easy in-and-out entrance or escape route, (3) street drug dealing happens at locations that generate opportunities for drug activity, and (4) high-dealing street segments are distinguishable from high-dealing intersections on the situational characteristics they posses. A series of bivariate analyses (using McNemar's test) and a multivariate analysis (using conditional logistic regression) are conducted. Analytical procedures presented in the last chapter yield several general results, which are summarized in accordance to the hypotheses below.

1. Street drug dealing happens at street segments that lack capable guardians, are highly accessible, and generate opportunities for drug activity.

The bivariate analyses of the street segment data show that most of the situational

variables, which are the aba*ndoned building, bus stop, parking lot, vacant land, retail facility*, and *church*, significantly distinguish drug market streets from drug-free streets. These results support the hypotheses that when a street segment lacks guardians (i.e. the presence of vacant land or abandoned buildings, or the absence of churches), appears easily accessible (i.e. the presence of bus stops), and possesses crime generators (i.e. the presence of parking lots or retail facilities), such a street segment is likely to be associated with a drug marketplace.

Putting everything together (in the multivariate models), the variables *abandoned building, bus stop, parking lot*, and *mailbox* are found to be significantly more prevalent on the drug market streets than on the drug-free streets. The variable *church* is found to be significantly less prevalent on the drug market streets than on the drug-free streets. These results support the causal hypotheses that when a street segment lacks guardians (i.e. the presence of abandoned buildings or absence of churches), appears easily accessible (i.e. the presence of bus stops), and possesses crime generators (i.e. the presence of parking lots or mailboxes), such a street segment is more likely to develop into a drug marketplace.

2. Street drug dealing happens at intersections that generate opportunities for drug activity.

The bivariate analyses of the intersection data show that the variable retail facility significantly distinguishes drug market intersections from drug-free intersections. This finding supports the hypothesis that when an intersection possesses crime generators (i.e. the presence of retail facilities), such an intersection is likely to be associated with a drug marketplace.

Further, the multivariate models show that the variables parking lot and retail facility are found to be significantly more prevalent on the drug market intersections than on the drug-free intersections. These results support the causal hypotheses that when an intersection possesses crime generators (i.e. the presence of parking lots or retail facilities), such an intersection is more likely to develop into a drug marketplace. Interestingly, the variable church is also found to be significantly more prevalent on the drug market intersections than on the drug-free intersections. This result contradicts the guardianship hypothesis of this dissertation. Rather than acting as a capable guardian, churches on intersections contribute to the development of drug marketplaces.

3. Drug-dealing activity has a different dynamic on street segments as opposed to intersections.

As suspected in Hypothesis 4 (see Chapter 5), high-dealing street segments are distinguishable from high-dealing intersections on the basis of the situational characteristics they possess. Analytical results from previous chapters have confirmed this hypothesis. Variables found to be significant in the street segment data are different from the ones in the intersection data. On street segments, situational factors such as abandoned buildings, bus stops, retail facilities (near vacant land), and parking lots contribute to the development of local drug markets. On intersections, situational factors such as parking lots, retail facilities and churches contribute to the development of local drug markets. These findings indicate that there are different sets of risk factors for street segments than for intersections.

In particular, when a church is on a street segment, it prevents the place from becoming a drug market; however, when a church is on an intersection, it contributes to the development of the local drug market. This finding suggests that situational factors

interact with the environment of street segments and intersections differently.

Table 25 *Summary of the Findings and Corresponding Hypotheses*

Theoretical Explanation	**Hypothesis**	**Situational Factor**	**Finding Confirms with the Hypothesis**
Guardianship	Related to the presence of a drug market	1. Abandoned Building 2. Vacant Land 3. Public Park	Yes No No
	Related to the absence of a drug market	4. Church	No
Accessibility	Related to the presence of a drug market	5. Bus Stop 6. Highway	Yes No
Crime Generator	Related to the presence of a drug market	7. Parking Lot 8. Retail Store	Yes Yes

Discussions

1. Differences between the Street Segment and Intersection Models

Recalling the bivariate analyses, among the eight independent variables, there are six variables found to differ significantly between the high-dealing streets and dealing-free streets (Table 3 in Chapter 7). On the contrary, however, there is only one that shows significant difference in the high-dealing intersections and dealing-free intersections – the presence of a retail store. According to Table 13 in Chapter 7, there are significantly more retail stores on the case intersections (N = 19) than on the control intersections (N = 9). The presence of a retail store on an intersection is significantly correlated with the existence of a drug market. Nonetheless, this finding also suggests that no other situational factors are significantly correlated with the drug market on intersections. This obvious difference between the street segment model and intersection model suggests a few caveats:

- **The intersection sample size is very small (N = 31)**

This is a main drawback of the intersection model. Recall that according to the case selection criterion in Chapter 6, if an intersection has more than five drug arrests in 2007, 2008, and 2009, respectively, then such intersection will be selected as a case. There are only 31 intersections that match this criterion. A small sample size is less powerful for detecting an effect.

The intersection model is thus unable to detect more significant variables, which may be because the sample size is too small to give sufficient statistical power. The majority of the variables on Table 13 in fact show a trend of presenting more often on case intersections than on control intersections: *abandoned building, bus stop, vacant land, mailbox,* and *church*. Despite the fact that these differences are not statistically significant, this trend hints that if the sample size were larger, the difference may have been significant.

Despite the small sample size, the retail store still shows a statistical significance, which suggests the retail store is a strong indicator of local drug markets. A retail store is a criminogenic venue for many kinds of crime: it is a target for offenders to shoplift goods, to rob the customers, or to rob the store itself. It is possible that the drug dealers use retail stores as a good venue for selling drugs, and that drug buyers may use the quick cash that they have just obtained from the robbery or shoplifting to buy the drugs.

- **Intersections are a relatively smaller geographic unit**

Intersections are a relatively smaller geographic unit, compared to the stretch of a street segment. Intuitively, when a street segment extends hundreds of feet, the chance of finding an abandoned building, a parking lot or vacant land is likely to be higher. Whereas an intersection is merely a spot combined by three or four street corners, and

therefore the chance of finding a public park or a mailbox is much lower.

Assume that the sample size of the intersection data is tripled (e.g. N = 93), similar to the sample size of the street segment (N = 104). It is then possible that the difference will be more distinct between the cases and the controls; i.e. we may find significantly more bus stops on the case intersections as compared to the control intersections.

- **Most of the intersections are sampled from the same major thoroughfares**

Because of the sampling procedure designed in this dissertation (see Chapter 6), most of the case intersections sampled are located on the same streets, for example, eight case intersections are located on Clinton Ave. Also because of the control selection criterion, case intersections must share the same major thoroughfare with their paired controls. Therefore, 16 total intersections are all located on Clinton Ave.

This fact contributes to less physical variability among the cases and controls. In other words, it is more difficult to find differences between the cases and the controls, because they are so close to each other and are sharing the same major thoroughfare. For example, there might be retail stores on each intersection because it is a very busy commercial street, or there might be a large public park that many intersections share.

- **Influential social characteristics are unmeasured**

It is possible that some unmeasured social characteristics are important. They may be correlated with the social dynamic of a place. For example, physical disorder characteristics, such as loitering and drinking in public, are commonly found at high-dealing locations. Or, for example, place management features, such as property owners, are commonly found to deter drug activities on a street segment or intersection; however,

this dissertation does not directly address this concept. It is possible that they are significant situational factors contributing to the development of local drug markets but are not captured in the analyses in this dissertation. It is possible to find similarity among street segments and intersections regarding these characteristics.

2. The Importance of Identifying Risk and Protective Factors of Places

The findings from the analyses here suggest that crime researchers and crime policy practitioners can identify key situational factors of street segments and intersections that are correlated with local drug markets. The presence of abandoned buildings, bus stops, retail stores, parking lots, and other physical features on street segments or intersections are likely to increase the risk of such place turning into a local drug marketplace, while on street segments the presence of a church can significantly reduce the risk. This finding emphasizes the potential for reducing drug dealing activity by stressing the church's presence in the area or encouraging more community outreach activities organized by the church. Churches (while located on street segments) serve as a strong yet unofficial protective factor of a place. They function as an unobtrusive way to interact with the neighborhood, as opposed to the police. On the contrary, churches (while on intersections) act as a strong risk factor of a place. They generate opportunities for drug dealing by providing a place for dealers and potential buyers to hang out and interact.

When new retail stores are opened on streets, when new rental apartment properties are built, or when new bus stops are implemented, the police should prepare to prevent drug activity from emerging in such places. The official deterrence through police presence or private security is likely to work. However, crime prevention

opportunities should not be limited to the police. Particularly in disadvantaged neighborhoods, churches take on a supportive and protective role, and the situational interventions to control these situational risk factors should not be implemented too intrusively. That is to say, crime researchers and the police may tailor a more holistic intervention to address drug-dealing problems, incorporating community leaders, church staff, active residents, business managers, or even parking lot attendants and bartenders to control their specific elements of the environment so as to tackle the local drug-dealing activities.

3. Theoretical Strengths of the Study

This dissertation provides several important implications for the field of criminology, which are discussed as follows:

- **Situational factors and street drug dealing**

Many of the situational factors examined in this dissertation have not been emphasized in the drug market literature. This dissertation uses a situational approach to focus on analyzing the dealing event itself, contrary to the typical criminological analyses that investigate the "root causes" of criminality based upon the links between criminal traits and social control dynamic. Criminological research has often applied certain traditional criminological theories to explain illegal drug market problems. One of the theoretical implications of this dissertation is to show that the field of environmental criminology is a preferable theoretical approach for studying street-level drug dealing behavior patterns. Also, it shows that the field of environmental criminology is a suitable approach for rationalizing how dealers interpret their surroundings, and how they benefit from the unique environment. This dissertation is concerned with the role that situational

factors play in shaping law-violating behaviors, and especially in structuring opportunities for drug-dealing in particular places in a crime-ridden neighborhood.

Accordingly, the theoretical underpinnings of this dissertation lie in environmental criminology: rational choice perspective, routine activity theory, and crime pattern theory. A core concept in this theoretical approach is opportunity. When a location lacks capable guardians, is highly accessible, and generates opportunities for crime, drug dealers may take advantage of the opportunity, and thus such locations are more likely to turn into a drug marketplace. A situational model of drug dealing was developed on this foundation (see Chapter 5). This proposed situational model confirms our understanding of street-level drug markets and contributes to our understanding of these environmental theories.

In particular, the routine activity approach indicates that there are three elements required for crimes to happen: a likely offender, a suitable target, and the absence of a capable guardian against crime. Most crimes require the convergence in space and time of the three elements. The proposed situational model supports the routine activity concept that if a place lacks capable guardians, it is more vulnerable to use by dealers for drug sales. When there are abandoned buildings or vacant land at a place, it lacks place managers. The place is prone to drug market activity. The rational choice perspective asserts that the pattern of an individual's behavior reflects the rational choices made according to his free will. The motives and actions of offenders are in continual interaction with opportunities and constraints in their surrounding environment. The proposed situational model also supports the rational choice perspective. If a place seems easy to enter and exit, it is more likely to be selected by dealers for drug sales. When

there are bus stops at a place, it is highly accessible. The place is prone to drug market activity. The crime pattern theory suggests that crimes are patterned and the process of committing a crime is also patterned; crimes often occur on major pathways or nodes corresponding to an individual's daily routine, where large numbers of potential offenders and targets are brought together, and thus crime generators are unintentionally created by high flows of people overlapping at activity locations. The proposed model supports the crime pattern concept that if a place unintentionally generates opportunities for crime, it is more likely to turn into a natural location for drug sales of which the dealers can take advantage. When there are parking lots or retail-related stores at a place, it generates opportunities for crime. This place is prone to drug market activity. These situational factors examined in this dissertation have not yet been emphasized in the drug market literature.

Furthermore, this dissertation touches upon the broken windows concept at the level of street segments and intersections. The abandoned building and vacant land variables are categorized as guardianship features in this dissertation; however, they are also commonly considered as physical disorder features in many situational crime studies. The broken windows concept has been studied as a social disorganization process at larger geographic units, such as communities (Weisburd et al., 2012). Weisburd et al. (2012) examined the relevance of broken windows and social disorganization mechanisms at micro-level places. They pointed out that the impact of broken windows and social disorganization on crime has been mostly described using much larger units of analysis, like communities and neighborhoods, rather than street segments. It has been uncertain if such a process operates at a smaller geographic level like street segments or

intersections, and their findings reveal strong evidence of concentrations of broken-windows traits at micro-level places. This dissertation indirectly tests broken windows factors (abandoned building and vacant land) to assess the dynamic of drug dealing at the level of segments and intersections, and also finds the significance of these variables at these geographic units.

- **Church and mailbox as crime generators**

This dissertation examines the influence of churches and mailboxes on drug market locations. These two situational factors have not yet been emphasized in the previous literature. It is hypothesized in this dissertation that churches act as capable guardians and prevent a place from developing into a local drug market. The statistical findings, however, yield mixed results. When a church is on a street segment, this segment is likely to be free of drug dealing activity. It is possible that when a church is located on a street segment, it acts as a guardian and prevents drug activity to take place. However, when a church is on an intersection, this intersection is likely to be associated with a drug market. It is possible that when a church is located on an intersection, it serves as a hangout for individuals. An intersection is a location where individuals frequently converge and interact with each other. Drug dealers can find more potential customers on intersections. This dissertation thus suggests that churches may actually be crime generators under certain conditions.

Newark narcotics unit officers suggest that the situational factor mailbox is a risk factor for street drug markets. It is hypothesized that mailboxes act as drop-off locations for drug transactions. The statistical findings confirm this hypothesis. This dissertation suggests that the role of mailboxes in the street drug market is to act as a crime generator.

- **Criminology of Place**

Previous crime studies on the importance of place are examined further by this dissertation. A key requirement for an application of the criminology of place is that crime is heavily concentrated in crime hot spots (Sherman et al., 1989; Sherman & Weisburd, 1995; Weisburd & Green, 1995). The tight relationship of crime and place would predict stability in the concentration of crime at place, which indicates the fact that there are specific processes that draw crime to concentrate at particular places. This dissertation supports such a proposition. The findings in Chapter 7 suggest that certain characteristics, such as bus stops or parking lots, are consistently found to be concentrated on high-dealing streets, as is the concentration of drug-dealing activity. Echoing Weisburd and colleagues (2012), it is possible that the concentration of crime is in fact related to the overall distribution of social and environmental characteristics of place in the city. The stability of patterns of businesses and properties in a city is mostly a reflection of the more general patterns of concentration that are related to the growth and development of an urban area. Certainly cities control such concentrations, by regulating commercial, residential, and industrial areas. Thus, it is likely that the general concentrations of crime are simply a reflection of the general concentrations of other social activities in the city.

4. Methodological Limitations

There are a few methodological concerns requiring caution:

- **Potential biases in the data**

The drug dealing locations (i.e. the cases) were selected solely depending on the official police arrest records. This dissertation assumes that the locations where arrests

were made are equivalent to the locations where drug transactions were conducted. However, a location reported in the police data may be the end point of the officer's foot pursuit of the suspect, rather than the point at which the drug deal was actually conducted. A location reported in the police data may also be an officer's guess as to the actual point of transaction. These dealing locations were identified through the eyes of the police.

More critically, the frequency of dealing in these locations was defined and reinforced as a direct result of police action. These locations may be targeted by proactive (preventive) police strategies; the police officers may have conducted more frequent "directed patrols" in these areas, and thus these locations yielded more arrests. Because of the unavailability of a second data source for 2007 - 2009, such as citizen calls, informants, or narcotics tip-line information (see Weisburd & Green, 1995) to verify the validity of the dealing locations sampled, any bias in the information in these arrest records may lead to inconsistencies in further analysis.

- **Concerns in using a matched case-control design**

Selection of controls is difficult. An ideal method is to choose controls that can represent a general population, and a randomly sampled control group is the exemplar. Because drug markets are not evenly distributed in Newark, a random selection of dealing-free locations is not feasible. In this dissertation, the control is selected by matching controls to cases based on characteristics related to the outcome (high concentration of dealing activity). However, it is possible that the matched controls still differ from the cases in uncontrollable ways that could be confounded with the presumed causes and may be the actual cause of the outcome (Shadish et al., 2002). Thus, what

factors ought to be controlled as possible confounders requires additional consideration.

Once a matching variable has been selected as a confounder, it is not possible to analyze it as a risk factor (Lewallen & Courtright, 1998). In this dissertation, street segment length is controlled as the confounder, because it is not presumed to be a risky *situational* factor to be analyzed. Controlling the segment length can justify the influence it might impose on the outcome via other causes. There might be other hidden confounding factors neglected by this research design, which it is expected will be revealed in future analysis. In addition, to avoid the common methodological issue in many case-control studies, overmatching, no other factor is considered as a confounder in this dissertation.

Using multiple controls can help avoid these problems, as registering differences between the controls in estimates helps to index the amount of unobserved bias that might exist, as well as increase the statistical power (Kleinbaum, Kupper, & Morgenstern, 1982).

- **Weaknesses of the control sampling process**

Drug-dealing activities tend to cluster together, and streets neighboring the case locations are likely to also have high numbers of drug arrests (but relatively lower than the arrest number at the case locations).Thus it is hardly possible to detect arrest-free locations in very close proximity to the cases. Although Weisburd and Green (1995) have suggested that a drug market is active within a one-block radius, this dissertation, due to the nature of drug markets in Newark, allows comparison between two locations beyond the one-block distance. This dissertation uses 1,114 feet, a three-block distance, as the search radius to sample the controls. This control sampling process may be subject to the selection bias of moderation, or it may also decrease the chance of finding significant

contrasts if the control location were closer.

- **Small Sample Size for the Intersection Dataset**

A good statistical study is one that is well-designed and yields valid conclusions. Two key factors that affect the "power" of a study are the sample size and the effect size. A study with a low statistical power has a reduced chance of detecting a true effect, and a low power also reduces the likelihood that a significant result reflects a true effect. In other words, effects are more difficult to detect in smaller samples. The sample size determines the degree of sampling error inherent in a test result. A study that has a small sample size may produce inconclusive results.

In this dissertation, there are only 31 high-dealing intersections identified from the sampling procedure, paired with 31 dealing-free intersections from nearby. As mentioned in Chapter 7, such small sample size (N = 31 pairs) prevents the multivariate model from analyzing the intersection data, due to the relatively large degree of freedom (there are eight situational variables, so the d.f. = 7).

- **The challenges of using Google Street View**

Although GSV allows quick access to images of the physical environment studied, and offers images precise enough for users to collect detailed street-level data, using GSV as a research tool is subject to a few limitations that require precautions.

First, using GSV for a virtual field audit is contingent upon a temporal alignment between the GSV images and the street data linked (Clarke et al., 2010). GSV does not capture any temporal difference, and does not offer additional street images of the same street. The time lapse between the date of the street photos taken and the date of the street data in the dataset might be more problematic for some characteristics than others. For

example, overgrown bushes will likely change sometime during 2007 - 2009, but a public park is less likely to change over time than the physical makeup of bus stops. A street segment may have five arrests in 2007, 8 arrests in 2008, and peak at 20 arrests in 2009, while the corresponding GSV images might be taken in 2008. In this case, GSV is not able to capture the most significant attributes in the year with the most serious dealing problem. Some situational characteristics mentioned in the previous literature are not applicable to this dissertation. For example, a bench used by a dealer waiting for a customer (Myhre, 2000) may be moved around and not captured on GSV; a black plastic trash bag tied to the fence outside a housing project used for dumping drug paraphernalia (Myhre, 2000) may be removed by garbage disposal services and not shown on GSV. These are some of the characteristics that constantly change over time and cannot be clearly assessed by GSV, and, thus, are excluded from further analysis.

Second, although GSV coverage continues to expand over time, it is not complete. GSV is more comprehensive in urban than rural areas, and is not available particularly for smaller streets inaccessible to vehicles. Some street units originally sampled for this dissertation are excluded because they cannot be observed via GSV.

Third, GSV does not capture more subtle signs of drug activity that have been frequently coded in social observation studies, like the presence of needles, cigarette butts and drug paraphernalia (Odgers et al., 2012). Prior in-person observation studies have indicated that these types of markers of social disorder, including evidence of drug paraphernalia, observations of drug trade actions, or other types of drug-related activity are not frequently captured; and when they are, they tend to be highly inter-correlated with other signs of social and physical disorder (Sampson & Raudenbush, 1999). Many

situational characteristics summarized in the literature reviewed in Chapter 4 have to be excluded because they cannot be observed using GSV, and that these excluded variables are likely to be highly influential to the physical disorder variables analyzed in the model.

Fourth, it is impossible to implement GSV for factors such as noise, odors, and certain measures with a temporal dimension, such as traffic speed and volume (Rundle et al., 2011). It is also impossible to capture the intensity of sunlight or the degree of street lighting. For these reasons, certain situational characteristics originally summarized in Chapter 4, including poor street lighting and shaded street corners, are excluded from further analysis.

Thus, the principle of employing GSV in this dissertation is that only those situational characteristics that are stable and can be *directly* observed using the Google Street View are included for analysis in this dissertation.

Conclusions

1. Policy Implications

This dissertation is designed to address the situational factors studied and to provide opportunity-reduction interventions for current drug-control policy. Local drug markets are of great interest to law enforcement because of the variety of crime policies tackling them. They have been the subject of police crackdowns (Zimmer, 1987, Boyum, Caulkins, & Kleiman, 2010), and "problem-solving policing" efforts (Weisel, 1990). This dissertation explores several situational characteristics suggested by the literature that the law enforcement could apply to control and disrupt local drug market concerns.

It is found that these situational factors studied do differentiate drug market locations from dealing-free places across Newark. The key recommendation of these

policies thus is to intervene on immediate situational factors of the crime settings that can be manipulated and regulated. This approach follows environmental criminology's core assumption that criminals, like other human beings, are rational individuals. Someone about to commit a drug sale crime must reflect before acting, thinking about risks, costs, efforts, and benefits, even if just for a slight moment (Felson, 2005). Accordingly, this dissertation provides several interventions tailored to increase the risks and obstacles for drug dealers, changing their perception on the costs and benefits of the crime act. Such policies offer alternative approaches to criminal justice agencies, community members, business owners, and other general public involved in the continuing efforts to reduce drug activity in Newark.

Concentrations of drug dealing activities are predictable. Data here have reinforced the conclusion that drug activity is bound tightly to place by specific characteristics of that place. Drug dealing activity at place is systematically related to the specific features of opportunity in the surrounding. For law enforcement and intervention, proactively targeting these situational factors should prevent local drug markets from developing. For example, locations that have frequent dealing activity are those where the built environment has deteriorated and been obscured, and where dealing activity is tolerated (Conner & Burns, 1991). Or, locations that have the most drug dealing activity are those located close to inter-state highways so the dealers can escape apprehension easily (Rengert et al., 2005). Based on these principles, it is assumed that locations with frequent drug dealing activity may be eliminated if their physical environment is modified such that the place is no longer favorable to drug dealers. The policy implications for drug-dealing activity in Newark can be divided into four interventions:

Implementing capable guardians; controlling access to an area; and monitoring and regulating crime generators. Each of these interventions is illustrated in the following:

(1) Implementing capable guardians

Having a security device around, such as a surveillance camera and motion sensor lighting, is suggested to be a useful situational implementation to deter drug-dealing activities (Conner & Burns, 1991; De Souza, 2010; Edmunds, et al., 1996; Lupton, et al., 2002; May, Edmunds, Hough, 1999; May et al., 2000; and Myhre, 2000). Implementing motion detectors at a corner of vacant land monitoring pedestrian activities, or surveillance cameras at the entrance of a dilapidated building blocking accessibility, appears to impose a greater threat to the dealing activities (Eck, 1995; Conner & Burns, 1991). Cleaning up a small local public park by improving its playground equipment, managing trees and gardens, and improving or repositioning street lighting may disrupt drug dealers' access to the park for business (Eck, 1995; Conner & Burns, 1991). Knuttson (1997) also mentioned that the installations of "dog toilets" in an unguarded park in Sweden encouraged more park users to frequent the area and indirectly suppressed drug dealing activities.

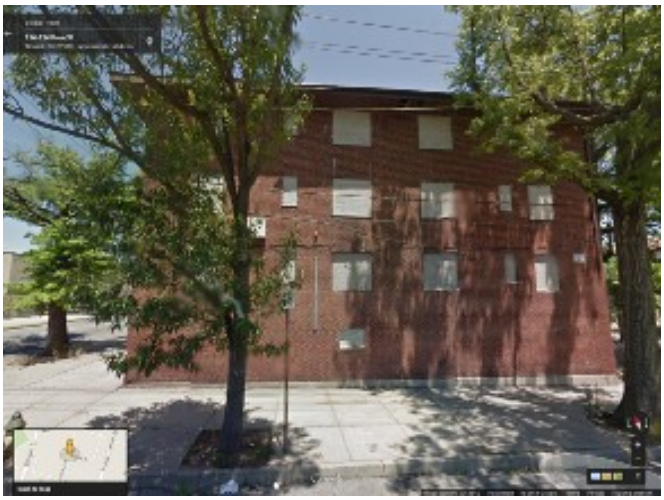


Figure 22 Boarded-up abandoned building

(2) Controlling accessibility to an area

The geographic variables examined in the multivariate model in this dissertation, *highway* and *one-way,* are insignificant. That is, from this sample and analysis, the geography (the location) of a street does not contribute to whether or not it will develop into a drug marketplace. Even so, many successful environmental interventions have proved that accessibility is a key factor in discouraging crime. Some crime research finds that access control is critical in preventing theft and robberies (Poyner & Webb, 1987; Poyner, 1994). Road closure, for example, has been found effective in deflecting cruising in a North London suburb (Clarke, 1997: p.19). Speed bumps, traffic lights and stop signs can also disturb a dealer's escape plan. In particular, many studies have supported environmental prevention that disrupts routes into and out of drug market locations, such as a *cul-de-sac* or U-shaped street. Jacobson (1999) suggested that controlling walkways in a drug-ridden neighborhood may be effective in disrupting dealing activities. Rengert and colleagues (2000) suggested that street patterns surrounding dealing locations, such as the exits from major interstate highways and easy in-and-out routes near drive-through restaurants, should be rearranged and replaced by one-way streets or dead-end streets (also see Rengert, 1996; Eck, 1994; Myhre, 2000; and Kleiman & Young, 1995). Conner and Burns (1991) suggests that erecting fences, gates and barriers, which are interrelated to drug dealers' escape routes, may deter local drug dealing problems. These studies support the proposition that situational interventions to suppress access and deflect drug dealers are successful in reducing opportunity for drug sale.

*Figure 23 S*peed bump in a residential area near a highway exit

(3) Monitoring and regulating Crime Generators

Eck (1995) suggested that drug dealers locate suitable dealing locations via their daily activity routes. These dealers are familiar with the setting of these locations, so they are more comfortable committing drug transactions in the locations. The environment often contains physical features that help offenders avoid the police. Findings from this dissertation suggest that urban planners and architects may incorporate opportunity-reducing interventions to physically change the environmental design of these locations. For example, avoiding the creation of shaded corners, and implementing extra lighting and surveillance cameras in a parking facility are situational interventions to reduce the opportunity of drug dealers using parking lots to conduct drug sales. Eliminating shaded corners in a parking facility reduces suitable locations that could hide criminal activities, and implementing extra lighting and surveillance imposes greater threats of apprehension to the drug dealers. Deploying security officers driving in the parking lot of a shopping plaza is also a situational intervention to reduce the opportunity for drug sales. Having a security vehicle driving around monitoring the parking lot increases the risk if drug dealers and buyers are meeting up, and thus could deter potential drug activity.

Figure 24 Surveillance cameras in a parking lot of a shopping plaza

Retail business-related facilities are found by crime research to be a very strong predictor for crime. Bars, for example, are crime generators providing opportunities for drug activities. The intoxication of bar-goers increases their vulnerability to drug sales, and the fact that the bars are open late at night reduces the risk of illegal activities being seen by other law-abiding residents. It is thus suggested that the police build cooperative relationships with bar owners, so that illegal drug activity can be suppressed by both official and unofficial authorities.

Other retail business-related facilities studied in this dissertation, such as pawnshops, barbershops, and convenience stores, are retail facilities that usually involve quick cash transactions. Illegal drug transactions can easily blend in with the normal cash-goods exchange behaviors in the stores. This situation is worsened when the stores are located on intersections, as found by this dissertation. A retail facility is a strong predictor of local drug markets on intersections; because of the convenience of the location and more pedestrians crossing and meeting at the intersections. It is thus suggested that the law enforcement agencies or the community collaborate with the place

manager – the business managers or property owners, to tackle local drug problems (Mazerolle, Kadleck, & Roehl, 1998) and to reinforce the functions of the place manger: regulating activities inside the properties, monitoring individuals using the facilities, and actively reporting suspicious activities to the police.

Figure 25 Retail stores on busy intersections

2. Future Research

This dissertation conducts a micro-level of analysis of the factors surrounding frequent drug dealing locations, through virtual observations, and by employing a structured coding instrument to provide specific descriptions of observational items of interest, so that the inter-rater reliability agreements could be checked to ensure the data quality. These designs lead to as much objectivity as possible in the collecting of the information, and increasing the quality of the data to be studied. At the same time, in this dissertation, the author conducted field observations (via the police ride-along), and collected visual records of characteristics of the observed locations through photographs, making it more concrete to compare the situational characteristics in the virtual representation to the reality. This dissertation uses multiple approaches to verify the data, which makes the design stronger and the results more conclusive.

Matched case-control design is a promising research method for studying crime. This dissertation provides a basis for comparing situational factors and drug market locations in frequent-dealing locations with those same factors in dealing-free locations in Newark. It suggests these factors are contributing reasons for the presence of local drug markets. Such a comparison helps advance the research field in understanding why drug activities often concentrate in certain street segments and intersections in a bad neighborhood while there are many drug-free streets and corners in the same neighborhood. Matched case-control design enables comparisons, which makes inferences stronger. Future research may employ the matched case-control design to study other crime types; for example, comparing buildings with frequent burglaries and buildings free of burglaries. Future research may also employ the design to study variables in other neighborhood theories; for example, comparing neighborhoods with frequent gun violence and neighborhoods free of gun violence on the basis of their demographic and socioeconomic characteristics.

This dissertation also offers an innovative approach, within the crime literature, to virtually observe neighborhoods as a low-cost and time-efficient alternative, which is very promising in the field of crime research. As found in Chapter 6, Google Street View reliably reflects true images of most of the items on the streets, with the exception of small subjects such as street litter. This raises an intriguing question as to whether we can use GSV images to capture physical disorder characteristics. It is often assumed that physical disorder factors are important situational factors correlated to street drug dealing activities. As suggested by the literature, physical disorder should be measured by observation rather than through the subjective perceptions of residents, because residents'

perceptions of disorder vary individually according to their victimization experiences, fear of crime, and socio-demographic characteristics (Perkins et al. 1993; Sampson & Raudenbush, 1999; Skogan, 1990; Taylor, 1995). Therefore, GSV may be a useful measure to collect such observational data (see Figure 26). Prior field research has attempted to rate the levels of street litter and graffiti based on how extensive they are, so they can closely evaluate the variability of physical disorder to the drug markets. Due to the limitation of GSV images on small items, future research using GSV may examine physical disorder by its presence or absence (Sampson & Raudenbush, 1999; Wei, Hipwell, Pardini, Beyers, & Loeber, 2005). Future research may employ GSV to further test its utility on observing physical disorder characteristics in neighborhoods.

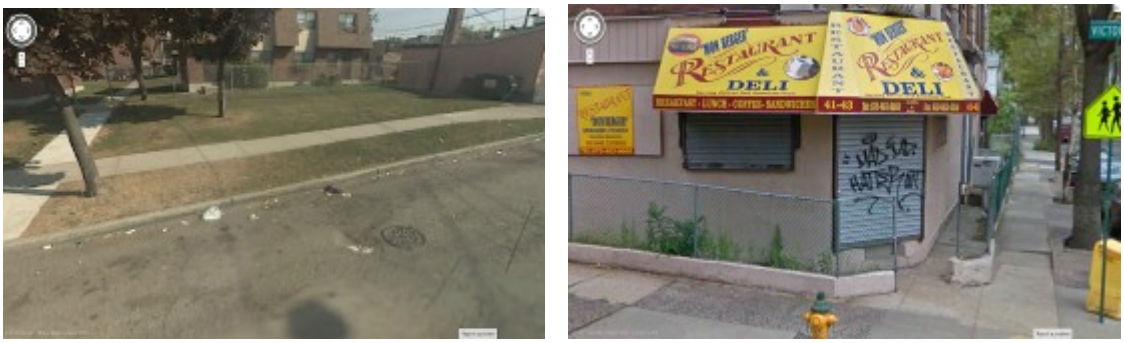


Figure 26 Evidence of litter and graffiti

This dissertation and other recent work, such as Weisburd and colleagues (2012), reinforce the importance of focusing on the "micro" level of places rather than larger geographic units such as communities or cities that have been the focus of attention in traditional crime prevention research. Findings from the data here suggest that crime prevention policies at larger geographic units may suffer from ineffectiveness because crime prevention resources are spread thinly across large neighborhood areas or districts when the drug problems that need to be addressed are clustered only on a few of the

street segments or intersections in the city. Crime prevention practitioners need to acknowledge that defining a neighborhood as “bad” is likely to neglect the reality that most of the places in such “bad” neighborhoods have little or no drug activities; and that crime prevention resources should be applied to the hot spots of drug-dealing activity with higher priorities. Future research may look at how to effectively distribute resources to street segments and intersections, respectively.

This dissertation offers a very practical, evidence-based recommendation to local police agencies to control and reduce street drug markets in Newark. The critical role of law enforcement in controlling local drug markets has been emphasized by prior studies (Edmunds et al., 1996); and identifying these factors helps the police implement more effective situational prevention practices, minimize street drug dealing activity, and prevent the further development of local drug activity and collateral crimes. The findings provide pragmatic strategies to deploy police resources so as to effectively combat local drug markets. Much future research is needed to investigate these and other situational factors at drug dealing locations in other cities, and then to deploy these situational interventions in local drug markets in other urban areas.

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APPENDIX – DATA COLLECTION INSTRUMENT

ASSESSMENT OF SITUATIONAL FACTORS Location: ____1. _____ Date of the GSV Image: _____		Date of the Coding: _____	
Variable Name	**Measure**	**Code**	
		Yes (1)	No (0)
1. Abandoned Building	Unsecured, Vacant building		
2. Bus Stop	Bus stop or bus stop shelter		
3. Parking Lot	Public, openly accessible, un-gated parking lot		
4. Vacant Land	Openly accessible, unsecured, unclaimed space		
5. Public Facility	Openly accessible park, playground, or basketball court		
6. Cemetery	Openly accessible cemetery		
7. Front Stoops	Stoops in front of a multi-unit property suitable for sitting on		
8. Retaining Wall	Fence or wall around a multi-family housing complex that is suitable for sitting on		
9. Mailbox	Public postal mailbox		
10. Retail Business-Related Store	Convenience store, grocery store, liquor store, bar, take-out food store (such as Chinese food delivery, fried chicken shop), pawnshop, barbershop, or nail salon.		
11. Church	Building used for religious activities		

CURRICULUM VITAE

Date and Place of Birth
August 26, 1983. Taipei, Taiwan

Secondary School Attended
September, 1998 – June, 2001
Taipei Jingmei Girls' High School

Universities Attended
September, 2001 – June, 2005
Bachelor of Arts, Economics
National Taipei University

September, 2005 – August, 2007
Master of Arts, Criminology and Criminal Justice
University of Maryland, College Park

September, 2009 – May, 2014
Doctor of Philosophy, Criminal Justice
Rutgers University, Newark, NJ

Principal Occupations and Positions
June, 2006 – August, 2006
Research Assistant, Office of International and Executive Programs, University of Maryland, College Park, MD

October, 2007 – February, 2009
Crime Analyst, Hagerstown Police Department, Hagerstown, MD

September, 2010 – May, 2012
Lecturer, Rutgers University, Newark, NJ

September, 2011 – May, 2012
Teaching Assistant, Rutgers University, Newark, NJ

January, 2012 – May, 2012
Research Assistant, Rutgers University, Newark, NJ

Publications
Sheu, C., Chen, Y., and Hsu, K. (2009). *Evaluation Report on the Practicality of Decriminalizing Adult Sex Workers in Taiwan.* Department of Social Affairs, Ministry of the Interior, Taipei, Taiwan.