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A Study of the Relationship Between Transportation Infrastructure and Criminal Behavior

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A STUDY OF THE RELATIONSHIP BETWEEN TRANSPORTATION INFRASTRUCTURE AND CRIMINAL BEHAVIOR

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Transportation is a cornerstone among public sector services and enjoys a long history of influence on the nation's culture. These influences emerge from divergent sources and affect each stratum in our social structure: drivers and pedestrians; transients and residents; wealthy and poor. Emergency services depend upon a reliable transportation network. Community activities come to a standstill when faced with weather-related road closures. Local economies suffer when the movement of goods and services is interrupted.

Transportation infrastructure also has influences that are much less obvious. This study explores the influence of transportation infrastructure on criminal behavior. Given the fact that crime is largely an opportunistic event, can communities reduce criminal behavior by removing the opportunities that attract it? Relatively new designs for transportation infrastructure may provide a possible intervention. This research explores opportunities for intervention that relate to transportation and the infrastructure alterations that communities may use to engineer a reduction in criminal behavior.

Finding the necessary resources to address public needs such as transportation and crime prevention is challenging, and often insufficient. Available funding is dwindling as needs continue to increase. Combining initiatives to expand the potential benefits may

provide viable options. Where possible, communities may be able to stretch existing resources by simultaneously addressing multiple issues with the same funds.

This study explores one aspect of this strategy by examining the influence of transportation infrastructure on criminal behavior. It has two primary objectives: (a) to determine whether transportation infrastructure projects have the potential to intervene and to deter crime; and (b) to explore the impact of this intervention relative to other elements that influence crime and delinquency. Employing a mixed-methods approach, the study initially examines secondary quantitative criminal data from boroughs across PA to determine patterns and variations in reported crimes before and after alterations in transportation infrastructure. Then, a case study further explores these variations by providing a more detailed understanding of the effect of transportation infrastructure on criminal behavior in a single community. The results of this study introduce community decision-makers to additional information for making informed decisions regarding community investments.

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"*It is good to have an end to journey toward;*

but it is the journey that matters in the end."

Ursula K. Le Guin,
The Left Hand of Darkness (Guin, 1969)

While the end of this journey brings tremendous relief and satisfaction as any doctoral student can attest, looking back to that point of departure, I realize just how far I have actually come. Although at times I felt that I was simply putting my life aside for this commitment, I am reminded that this doctoral journey, for a period of time, *was* my life. It was not just a series of academic hurdles, but a journey within. Much like terrain, and storms, and vistas, and communities mark memorable journeys, this one has shaped me, broadened my perspective, toughened my desire, challenged my endurance, strengthened my character, and stretched my academic abilities.

Yet no journey of this magnitude is ever accomplished alone. I have many to thank for their steadfast guidance and unrelenting support along the way. First, I thank God for blessing me with this opportunity to further my education, and for the perseverance to see it through. I also am grateful for the dedicated faculty at IUP who taught my courses and served on my dissertation committee. Their insight, expertise, and guidance not only improved the quality and clarity of this dissertation, but also helped to "weave me in" to a distinguished group of academic professionals. Among them, I am especially grateful for Dr. John Anderson, chair of my dissertation committee, academic advisor, mentor, boss, advocate, and friend. Dr. Anderson invested countless hours instructing, advising, reviewing, editing, and, overall, challenging my intellect. More importantly, he encouraged and supported me throughout this long journey. He gave me

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"Education is not preparation for life; education is life itself."

- John Dewey, Academic, Philosopher, Educator

Dedicated with love to my family

my mother, Veletta Bennett;
my sister and brothers, Karen, Darren, and Craig
my amazing children, Aaron and Alyson Zimmerman;
and the unending love, support, and sacrifice of my loving husband, John Chippo

In loving memory of my father

Donald Jack Bennett

who left this world before he could share in the joy of this occasion; who encouraged my dreams and assured me that I could achieve them; who lived his life as a promise of a better one for his children; who showed us the value of love and laughter; and who always believed that this day would come.

You are deeply loved and sorely missed!

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CHAPTER I

INTRODUCTION

Transportation has remained in the forefront of our Nation's history and economy for over a century. The invention of the automobile, the influx of mass transit, and the introduction of the "Super Highway" have shaped the way that Americans live, work, and prosper. Courtesy of our ever-evolving transportation networks and hubs, communities emerged followed by suburbs, providing havens from the urban grind and hubs of economic vitality.

As the cornerstone among public sector services, transportation continues to influence American lives and communities. It continues to evolve from divergent sources, taking shape from vested interests and influencing each stratum of our social structure. Transportation influences the behavior of drivers and pedestrians as well as transients and residents. Emergency services depend upon on a reliable transportation network, since community activities come to a standstill during weather-related road closures. Ultimately, local, state, and federal economies suffer when interruptions impede the movement of goods and services.

Transportation, a familiar topic among social and economic theorists, was the focus of one of the nation's earliest sociologists, Charles Cooley. His first major paper and seminal work, released in 1894, was aptly entitled *The Theory of Transportation.* In his forward-thinking text, Cooley concluded that towns and cities tend to locate where transportation routes intersect. Recognizing the interrelationship between transportation and society, he noted "because transportation underlies social development it is in turn determined by it" (Cooley, 1894, p. 41).

Expanding on the linkages between social behavior and transportation, this study presents research relating to transportation's impact on criminal behavior in communities. However, to develop a backdrop for understanding social and economic linkages associated with transportation, the following first provides a brief overview of the role of highway transportation in the United States (US).

Highway Transportation's Social and Economic Context

Beginning as simple networks of cart paths and dirt roads connecting communities and allowing for improved mobility within and among them, transportation's role in the US has grown significantly, particularly during the Eisenhower Administrations. In *The Man Who Changed America,* Thomas Weingroff (2003) describes Eisenhower's early interest in roads as a young soldier. As a part of his entourage, Weingroff observes the former president's convoy from Washington D.C. to San Francisco on the Lincoln Highway. During his cross-country experience, President Dwight D. Eisenhower recognized the significant challenges facing America relative to transportation infrastructure. In his summary report, Eisenhower recommended that the nation place greater emphasis on producing better roads.

Eisenhower also recognized the value of better roads after witnessing Hitler's success during World War II. During this period, Germany's *Reichautobahn* or *Autobahn*, comprised of 2,400-miles of expressway, was constructed (Weingroff, Public Roads: Articles, 2003). This highway was built to withstand B17 bombers and served as a major asset during Hitler's "lightening war." As a defense logistics network, the Autobahn facilitated a massive coordination of air and ground attacks, provided for fighting on two different fronts, and delivered victories over much of Europe. Noting the

tremendous advantage that the Autobahn afforded Hitler in his war efforts, President Eisenhower resolved to use this model in the formulation of the US Federal Highway System. Eisenhower focused on the type of road building he observed in Germany. In the State of the Union Address in 1955, President Eisenhower announced his highway program, expressing the need for "a modern, efficient highway system (which is) essential to meet the needs of our growing population, our expanding economy, and our national security" (Weingroff, 2003, p. para.1). One year later, the enactment of the Federal-Aid Highway Act of 1956 (Act) created the largest public works project in American history. The Act sets forth the parameters of a 41,000-mile national system of interstate and defense highways across the US (Weingroff, Public Roads: Articles, 2003).

Eisenhower's improved highway system produced dramatic changes in the U.S. By connecting communities as well as cities and states, the system changed the social landscape permanently. It increased productivity, improved safety, and enhanced economic growth. Commemorating the fortieth anniversary of the Federal Highway System, Cox and Love (1996), co-authors of a 1996 report reviewing the US interstate highway system after 40 years, stated that the Dwight D. Eisenhower System of Interstate and Defense Highways proved to be "the best investment a nation ever made" (Cox & Love, 1996, p. 2). In so doing, they pointed out the following:

- It has enriched the quality of life for virtually every American.
- It has saved the lives of at least 187,000 people
- It has prevented injuries to nearly 12 million people.
- It has returned more than $6 in economic productivity for each $1 it cost.
- It has positioned the nation for improved international competitiveness.

- It has permitted the cherished freedom of personal mobility to flourish.
- It has enhanced international security. (Cox & Love, 1996, p. 2)

Cox and Love (1996) estimated that the combined benefits of the improved highway system from 1957-1996 were nearly $2.5 trillion or between six and seven and a half times the gross national investment in the system. These benefits include:

- Reduced fatalities by almost 60 percent over the rest of the system (Cox & Love, 1996)
- Saved four lives and avoided 250 injuries for each mile of urban interstate constructed (Cox & Love, 1996)
- Increased production cost savings among U.S. industries averaging 18 cents for every dollar invested annually from 1950 to 1989 (FHWA, 1996)
- Contributed over 21% on average in overall growth in technological change and innovation from 1950-1989 (FHWA, 1996)
- Provided user benefits through time savings and operating costs estimated at $0.7 to $1.1 trillion from 1957-1996 (Cox & Love, 1996)

As Cox and Love (1996) observed, the quantified benefits of the System neglected to capture all of the actual benefits. Aside from the quantified benefits, Cox and Love noted increased investment in business, increased opportunities and mobility for employment, more housing opportunities, greater economic freedom, and reduced the need for multi-purpose trips. It enabled low-income citizens to be more mobile, increased access to healthcare, improved security, and provided greater leisure time with many more options for vacation (Cox & Love, 1996, pp. 16-17). The by-products of

Eisenhower's efforts to safeguard national security have become safety, mobility, and economics.

While these examples illustrate obvious and significant influences for the nation as a whole, transportation's effects within our communities may be less obvious yet farther-reaching. Transportation infrastructure exists as part of the built environment along with housing, businesses, schools and parks. It constitutes a physical aspect of the communities in which Americans live. The built environment is an important factor shaping how people function and interact with one another. It is associated with public health (Brown & Kraft, 2008; Kovar & Crites, 2011; Krisberg, 2006), mental well-being (Guite, Clark, & Ackrill, 2006), sense of community (Wood, Frank, & Giles-Corti, 2010), mobility (Clarke, Ailshire, & Lantz, 2009), social cohesion and exclusion (Brantingham, Tita, Short, & Reid, 2012; Randolph, Ruming, & Murray, 2010), and crime (Wilcox, Quisenberry, & Jones, 2003; Rostami & Mandanipour, 2006; Matthews, Yang, Hayslett, & Ruback, 2010; Phan, Fefferman, Hui, & Brugge, 2010). While such linkages have broadened our understanding about how the built environment influences social behavior, more questions remain. This study limits the focus of these influences by specifically exploring the impact of transportation infrastructure on criminal behavior in communities.

Researcher Perspective

I spent much of my professional career working as both an employee for the Pennsylvania Department of Transportation (PennDOT), as well as a consultant within the transportation community. For the first 17 years of my career path, I worked in various management positions at PennDOT, advancing through several management

positions and overseeing a variety of functions including administration and budgeting, labor relations, training, safety, quality and productivity improvement, highway maintenance and operations, and community/public relations.

In my final position at PennDOT, I served as Director of the Bureau of Municipal Services. In that capacity, I was responsible for a $330 million annual transportation program and oversaw the statewide implementation of the local roads program, encompassing over 70,000 miles of roads, over 6,400 bridges, and 2,562 municipalities across the Commonwealth of Pennsylvania (PA). Our bureau provided many services to local governments to improve their local transportation systems within the limited funds available. These services included technical assistance on managing local road inventories, implementation of pavement preservation technologies, evaluation and approval of new products and technologies, winter and weather maintenance materials and technologies, localized technical training and assistance, asset inventory and management, and much more. From this perspective, I gained hands-on insight into the myriad of challenges faced by communities as they compete for transportation funding and struggle to make this funding stretch as far as practicable. Although I left PennDOT in 2005, I have worked with PennDOT and the Pennsylvania Turnpike Commission in a variety of consultant capacities since that time.

Through my role in the Bureau of Municipal Services at PennDOT, I became involved with the American Public Works Association (APWA). APWA is a professional association for Public Works professionals. This international organization provides educational programs, assessment programs, research on new processes and technologies, professional credentialing for managers and executives. It also serves as a

conduit for professional networking, benchmarking, and sharing best practices. Among the five major service areas under the responsibility of municipal public works agencies, transportation holds a prominent position in this international community. I have continued my active involvement with APWA throughout my career, serving on a variety of committees related to transportation and leadership for the past 15 years. Through participation in APWA's research, training, program development, strategic planning, and sustainability initiatives, my expertise and my professional network in transportation expanded well beyond the Commonwealth and enhanced my view of the big picture and a national perspective.

The concept for this study came from my personal experience in the industry. While working as the Transportation Client Services Director for an engineering firm, I provided support for a traffic redesign project in one of Pennsylvania's boroughs located within the south central region of the Commonwealth. As a community leader, the borough's Chief of Police was a strong advocate for the traffic redesign proposal. An expert in criminal behavior, he brought a unique perspective to transportation planning issues. Through his professional experience, he knew that the nature of crime was largely opportunistic, and that, where opportunities readily exist in an environment of broader social issues, criminal activity will persist. Removing the opportunities available to commit crimes will, in turn, reduce the number of actual criminal occurrences. From this standpoint, he speculated that some of the factors inherent to transportation infrastructure, if correctly manipulated, could alter criminal behaviors within the community by removing opportunities to commit crimes.

Based on the supposition that a direct correlation between traffic design/transportation infrastructure and criminal behavior exists, the borough offered this logic as a justification to increase the overall value of a project that was competing for federal funds. Drawing upon my transportation experience and recognizing the competition that exists among municipal governments for scarce funding, I realized that the concept of reducing criminal behavior, in addition to traditional benefits of improved transportation, might provide additional justification for competing transportation projects, bolstering a project's competitive advantage over other projects. In a world where dollars are at a premium, projects are expensive, and competition is stiff, projects that consider a broader range of community benefits stand a greater chance of securing funding. Leaders who make decisions regarding funding for infrastructure improvements must weigh the merits of these projects in light of their significant costs. Evidence of a relationship between transportation infrastructure and criminal behavior could provide additional information in this decision-making process. In addition to the prioritization and selection of transportation projects, a link between transportation infrastructure and criminal behavior may also offer new solutions for communities dealing with significant criminal activity. This reasoning serves as the basis for this study.

Statement of the Problem

Community leaders within the Commonwealth struggle constantly to meet the needs of their constituents. Based on the research and findings of the Pennsylvania Transportation Funding Advisory Commission (TFAC), critical infrastructure is aging and often failing. Additionally, costs for services are increasing due to inflation, and demands for new or improved services remain persistent. As expenses continue to rise,

revenues seem stagnant or close to declining. Budget shortfalls lead to neglect which further exacerbates the problem (TFAC, 2011).

Like many community needs, transportation needs far exceed the funding available. Experts in transportation funding project it will only get worse (TFAC, 2011). As fuel tax revenues decline, inflation increases, and transportation needs grow worse, the gap between funding and project needs will substantially increase. Pennsylvania's Transportation Funding Advisory Committee (TFAC) projected that this gap will more than double to $7.2 billion by 2020 due to transportation's prominence among other sectors: "Money is tight everywhere, but transportation supports every other sector and every aspect of modern life" (TFAC, 2011, p. 10). Based on these projections, as state and local governments apply for federal dollars, the pot of available funding is getting smaller, and what remains buys less and less.

In view of the eroding resources available, local and regional transportation projects face stiff competition for scarce state and federal funds. The Federal Highway Administration (FHWA) mandates that federally funded projects meet strict planning requirements and proceed through the Transportation Improvement Program (TIP) process. The TIP process includes a variety of planning partners who evaluate and rank the merits of regional transportation projects relative to land use, development, safety, and security (FHWA, 2013). Only selected projects receive the necessary funding. Competing projects must demonstrate unique benefits and address regional issues in order to qualify for serious consideration.

Similar to transportation funding challenges, communities face a variety of other demands for funds, including the monitoring and control of criminal behavior.

Information provided by the U.S. Department of Justice and the National Institute of Justice, working in collaboration with the National Highway Traffic Safety Administration, suggests that law enforcement professionals are concerned about the future of law enforcement based on the following presumptions:

- Resources allocated for law enforcement activities are frequently not sufficient to keep pace with the demands placed on agencies to respond to calls for service and threats to public safety.
- Decreasing social harm and improving quality of life for communities continue to be primary missions of law enforcement agencies.
- The need for police executives to provide timely and accurate data to justify expenditures and deployment decisions will only increase as Federal, State, and local officials, along with the public, continue to scrutinize the allocation of tax dollars.
- Technology has and will continue to improve the policies and practices of law enforcement. Existing and emerging technologies, such as wireless computers and license plate readers, along with the application of information technology, have greatly enhanced the effectiveness of law enforcement practices.
- Law enforcement agencies must collaborate and keep pace with other public and private service sectors that are turning to information technology to assess needs, deliver services, and manage costs.

- Community-focused, place-based law enforcement has emerged as an effective strategy for addressing current issues of social harm and concerns for public safety.
- Because a shortage of law enforcement resources is likely to continue in the foreseeable future, police executives should continue to explore new strategies to further improve quality of life in communities that suffer from the effects of high crime and crash rates (National Highway Traffic Safety Administration, 2009, p. ii).

The U.S. Census Bureau's 2012 Statistical Abstract summarizes state and local government expenditures from 1990 through 2008 (United States Census Bureau, 2012). Aside from education and public welfare, which alone total over 51% of all general expenditures, highways and police protection are among the largest expenditures for state and local governments. In PA, direct expenditures for state and local governments totaled $94.8 billion in 2008. Of this, $7.5 billion or 8% were spent on highways. Behind education ($33.1 billion or 35%) and public welfare ($22.8 billion or 24%), highways represent the third largest expenditure for state and local governments in PA. An additional $2.8 billion or 2% were spent on police protection (United States Census Bureau, 2012). Given the high costs for these public services, needs remain unmet, and good ideas fail to receive the requisite funding. Projects that address multiple priority areas may have a greater chance of receiving funding and provide a larger impact on the community per investment.

Purpose and Objectives of the Study

This study explores the influence of transportation infrastructure on criminal behavior in an effort to identify ways for communities to stretch available public resources. If transportation infrastructure investments can also help in controlling crime, then available resources can achieve greater results through improved planning and design. Focused primarily on community-based transportation infrastructure, the study excludes urban multi-modal assets such as mass transit and aviation. For purposes of this study, transportation elements are limited to those authorized by PennDOT for municipal expenditure of Liquid Fuels Funding (Bureau of Municipal Services, 2011). PA's Liquid Fuels Tax Municipal Allocation Law, Act 655, (Pennsylvania General Assembly, 1956) dedicates this funding source solely to transportation-related activities at the local or municipal government level.

Community enforcement activities and transportation-related construction and maintenance activities receive funding from separate, distinct, and often restricted sources. Projects funded from one dedicated source that can positively affect activities or responsibilities under a different dedicated source may result in combined efficiencies. This may lead to reduced budgets or increased services by freeing up additional resources.

The study has two primary objectives. The first is to determine whether transportation infrastructure has an effect on criminal behavior in communities relative to other elements that influence crime and delinquency. The second objective is to explore whether transportation infrastructure projects have the potential to intervene and to deter crime. The work undertaken employed the use of quantitative and qualitative data

analysis to explore and evaluate this impact. The results of this study may provide community decision-makers with additional information for making informed decisions regarding community investments.

Research Questions

Given the understanding of crime as a largely opportunistic event, communities may reduce criminal behavior by removing the opportunities that attract criminals. Based on this logic, the research questions explored through this study include the following:

1. Does transportation infrastructure have an effect on criminal behavior within communities?
2. If so, does this effect differ between serious crimes (I) and non-serious crimes and misdemeanors (II)?
3. Can transportation infrastructure serve as a viable social intervention that deters criminal behavior within communities while addressing transportation needs?
4. Can criminal opportunities or "hot spots" be limited or removed through improved designs for transportation infrastructure?
5. Do transportation infrastructure improvements improve a community's sense of security or guardianship, which can have an indirect relationship on crime?

Rationale and Significance

Existing literature in this area addresses some aspects of the study but fails to make a definitive connection between investment in transportation infrastructure and reduction in criminal behavior. The literature review includes a look at the relationship

between transportation and community, as in Jacobs' (1961) research regarding the influence that streets have on communities. It also includes more contemporary studies on regional planning (Katz, 1994; Behan, Maoh, & Kanaroglou, 2008; Duany & Speck, 2010) that address New Urbanism and "smart growth" for communities. Relative to transportation, the literature primarily focuses on reducing dependence on automobiles, reducing congestion, and eliminating sprawl by encouraging pedestrian-friendly and bike-friendly communities with easy access to public transportation. Improved quality of life and strengthened communities, which can influence crime, are also noted as secondary benefits; however, these relate more generally to community enhancements that focus expressly on transportation infrastructure as a factor.

Some of the existing literature presented in Chapter 2 links transportation and crime prevention, however more as a facilitator than an intervention. Recent studies have focused on employing a variety of transportation designs and modes as a means for facilitating or policing against criminal behavior. For example, Ross Petty (2006) reported in his article in *the International Journal of Police Science & Management* that transportation technologies can improve community law enforcement efforts by allowing police to be more engaged through various modes of transportation. Alternatively, transportation can provide easy egress for offenders fleeing a crime scene (National Highway Traffic Safety Administration, 2009). The United States Department of Transportation's (DOT's) initiative on Data-Driven Approaches to Crime and Traffic Safety (DDACTS) (National Highway Traffic Safety Administration, 2013) integrates location-based crime and traffic data for decisions regarding the deployment of law enforcement resources. Studies that originate from this program have identified a

number of relational factors between crime and motor vehicles. However, these connections do not consider the role that transportation infrastructure (i.e., roadways, curbs, lighting, traffic design, etc.) plays in either facilitating or discouraging criminal activity.

Transportation may play a larger role in our communities than simply allowing for movement of people and goods from place to place. As an integral part of our built environment, transportation can add to and detract from our neighborhood quality of life. In addition, transportation infrastructure may also intervene and deter criminal activity if properly designed, constructed, and maintained. To do so, deterrents must address the opportunistic nature of crime as well as motivation of the offender, and encourage social bonding and collective efficacy.

If evidence supports a causal relationship between transportation infrastructure and criminal behavior, the findings from this study could help community leaders face conflicting and competing demands for service. The findings may also enable them to make better-informed decisions on the use of limited resources. Results from this research will indicate if public investments have the potential to yield multiple benefits by improving community transportation infrastructure and reducing criminal activity.

Research Design Overview

The research design for this study represents an explanatory mixed methods design. Conducted in two segments, this study provides an initial statewide quantitative analysis to determine the relationship between crime and transportation infrastructure improvements on a statewide level, then moves into qualitative case study analysis of a single borough to further explore and explain this relationship.

Employing this mixed-methods approach, the study initially examines quantitative criminal data from 956 boroughs across PA to determine patterns and variations of reported crimes in response to changes in transportation infrastructure. This quantitative data includes crime type and frequency over a 6-year period, along with a number of demographic measures for control purposes. The primary case study provides qualitative insight for a more detailed understanding of the effect of transportation infrastructure has on criminal behavior within a community. This case study involves one specific borough with a completed transportation infrastructure project where decision-makers identified the reduction of criminal activity as a potential benefit in advance of the project design. This case study analysis uses secondary quantitative crime data, along with qualitative data collected through a series of one-on-one interviews, to explore the effect of these infrastructure improvements on the surrounding criminal activity within the borough.

Based on the length of time required to identify, fund, and implement transportation enhancements, the methodological approach used for the statewide quantitative analysis constitutes a post-only correlational design in conjunction with a cross-sectional analysis of crime data. While quantitative approaches focus on *objective* statistical relationships and patterns among key variables to reach conclusions, qualitative methods help to clarify, explain, and interpret *subjective* data in order to provide for a greater contextual understanding (Willis, 2007). Based on a socially constructed reality, qualitative methods reflect an understanding of how individuals interpret and make sense of the communities they live in (Willis, 2007). To account for this greater contextual awareness, I have included qualitative analysis as of the case study phase of this research.

This interpretivist approach provides a greater understanding into what these community representatives perceive concerning changes in their communities.

The case study includes a mix of quantitative and qualitative data to examine and understand the identified perceptions regarding the transportation infrastructure changes and criminal behaviors within a single borough. First, an analysis of quantitative data on reported criminal activity within the borough, along with data regarding incidents and complaints, collected as of routine police reporting during the study period provides a closer quantitative look at the effects of transportation infrastructure improvement on criminal activity in this specific case. I then combine this data with qualitative data gathered through a series of interviews with police officers, municipal employees, and business owners to complete the case study. The findings of this case study augment the findings from the statewide quantitative analysis by providing experiential grounding to the results. To inform the data analyses, I use a synthesis of criminological and social theories and factors that have been attributed with influencing social and criminal behavior and relate them to transportation infrastructure literature.

Terminology

The meaning of several key terms used frequently in this study should be clear from the beginning to understand the scope and implications of this study. The following definitions relate to the context of this study:

- Community refers to a smaller, localized area within a larger urban setting such as a city or borough where frequent interaction occurs among residents and patrons and elements of public infrastructure such as streets and sidewalks are shared among them.

- Criminal behavior is limited to the most common street offenses affecting PA communities based on 2011 crime data available through the Pennsylvania Uniform Crime Reporting System 2011 Annual Report (2011). These offenses include rape, robbery, aggravated assault, burglary, larceny (non-violent theft), motor vehicle theft, vandalism, weapons possession, prostitution, sex offenses, drug abuse violations, drunkenness, disorderly conduct, and vagrancy.
- Transportation infrastructure includes elements of the built environment funded through dedicated transportation funding. More details on this are provided in Chapter 2.

Assumptions, Limitations, and Delimitations

The study incorporates several assumptions that carry with them some limitations. First, secondary data collected from local and/or regional enforcement agencies and the DOT are assumed to be the most accurate, complete, and current data available. Although many crimes go unreported and unknown, the data collected and maintained by local and/or regional enforcement agencies and the DOT provides the best available and reliable data. This government-provided data adds credibility to the overall study.

Second, qualitative data gathered through one-on-one interviews are presumed to reflect honest and valid perceptions from those interviewed. Views expressed by the respondents do not reflect factual outcomes and are only perceptions of their reality. While they may not be factual, the perceptions of these individuals regarding changes in criminal behavior, along with their sense of security and guardianship in their

community, provides a better understanding of the impact of the transportation infrastructure project.

One weakness of this study is the cross-sectional statewide approach used to identify transportation infrastructure projects. The transportation project data used for the statewide analysis in the statewide analysis provides only basic information about the projects. It includes municipality name, project costs, start date, completion date, and a short description. This information was useful in determining the size of the project in an effort to exclude minor projects. However, it does not provide sufficient detail on the type of project or the location within the borough to further assess the effect that proximity or project elements may have on criminal behavior. This approach does provide a gross measure of the relationship between crime and transportation infrastructure, however it is not a very sensitive measure in that it may not accurately measure what I had intended.

Alternatively, considering the length of time required to identify, fund, and implement transportation infrastructure projects, this cross-sectional approach enabled me to identify boroughs that completed projects during the study period. This criterion for determining eligible transportation infrastructure projects also provides consistency in assessing the level of transportation infrastructure project activity within the sample population. Using this cross-sectional approach also provides a broader, more comprehensive population for analysis that balances out regional influences and provides results that are more generalizable to the target population.

The case study analysis presents another weakness or vulnerability. While focusing on a single borough as a case study for gathering qualitative data through the

one-on-one interviews offers an in-depth understanding of the complex issues of crime and transportation infrastructure in communities, the detailed contextual analysis of this single case cannot be generalized to a larger population. To account for this, I selected a mixed methods model. This model combined the results of the qualitative case study research with the statewide quantitative analysis to supplement the overall results. This triangulation of data through converging evidence helps to strengthen the findings of this research.

Chapter Summary

This chapter describes the impact of transportation infrastructure impact on communities. From safety and economic development to quality of life, investments in transportation infrastructure improve communities dramatically. Despite these efforts, however, funding shortages continue to exist across government programs and tend to stifle greater progress relative to transportation infrastructure. The research questions posed herein suggest that, through prioritization and design, transportation infrastructure can do more than serve transportation needs. Beyond these constraints, communities can find ways to combine benefits with other service areas such as police protection to increase the overall value of transportation projects and win public support.

This dissertation is presented in five distinct chapters. Chapter 1 provides the context for the study, a researcher's position statement, a general overview of the study, the rationale behind this research, and the research scope. Chapter 2 provides a literature review of the various regulations applicable to expenditures governing transportation projects as well as a comprehensive review of reports and studies that address criminal behavior in communities. It also focuses on relevant functions of community

transportation infrastructure, new urbanism and "smart growth" community planning, and crime prevention through environmental design. It culminates in a synthesis of the theoretical perspectives and a conceptual design that guides the methods used. Chapter 3 details the research methodology, and includes an explanation of the data collection and analysis procedures as well as the selected performance measures for evaluation of the relationship between transportation infrastructure and criminal behavior. Chapter 4 presents the analytical details and concludes with the results of the analysis. Chapter 5 presents a discussion of the findings, conclusions, policy implications, and recommendations for further research.

CHAPTER II

REVIEW OF RELATED LITERATURE

The purpose of this study is to explore the influence of transportation infrastructure on criminal behavior in an effort to identify ways for communities to stretch available public resources. This chapter provides an overview of the relevant research and theoretical literature that served as the foundation for this study. Topics addressed include crime and delinquent behavior, community and the built environment, transportation-specific infrastructure projects, and regulations governing transportation-related expenditures. The literature review provides a logical presentation of previous research findings and thought processes that paved the way for the formulation of hypotheses regarding the relationship between transportation infrastructure and criminal behavior. It also summarizes the "state of the research" relative to transportation and criminal behavior.

This chapter begins with a discussion of the theoretical background in sociological and criminological theories. This discussion provides an understanding of the nature of criminal and delinquent behavior to help establish the parameters for arriving at a conceptual framework for this research. Initially, the discussion focuses on theories that explain the psycho-sociological and sociological influences on individuals that motivate criminal behavior. Following this, the discussion moves to theories that address the cultural influences that predispose individuals to crime either as victims or as offenders. The theoretical background concludes with a synthesis of the foregoing theories, identifying their relationships and connections, and culminating in a conceptual framework that suggests opportunities for intervention.

Moving beyond the theoretical background, this chapter also includes examples of public policy and community-based initiatives linking criminal behavior to transportation and infrastructure. In some cases, data collected from transportation-related activities offers additional information that aids in targeting the enforcement of criminal behavior. In other cases, strategically designed infrastructure projects alter the social dynamics within communities and effectively deter criminal behavior. While literature on the relationship between transportation infrastructure and criminal behavior is minimal, the research findings and the specific theories combine to form a context for exploring direct linkages between transportation-specific infrastructure projects and the deterrence of crime and delinquency.

Theoretical Background

Theoretical and methodological developments in criminology have changed dramatically over time. As far back as the Middle Ages, early criminological theories paralleled early sociological theories as social and criminal theorists endeavored to understand criminal behavior. Theories and explanations for criminal theory, like social theory, began to develop as Western European societies began modernizing around the 15th century. These early theories focused on identifying the source(s) of offender motivation by posing the question, "What motivates offenders to commit a crime?" These sources ranged from "otherworldly powers" to material objects and events in this world (Vold, Bernard, & Snipes, 2002).

One of the first explanations for criminal behavior was spiritualism (Tannenbaum, 1938). Spiritualism explains criminal behavior as a conflict between good and evil, asserting that demons influence those who committed crimes. Classical theorists

believed that those who choose evil over good would receive religious sanctions both in this life and in the next for their crimes (Gottfredson & Hirshi, 1990).

Naturalistic approaches gradually replaced spiritualism in the mid 1700's when classical criminology, like classical social theory, began to focus on free-will rationalism. Under classical criminology, crime was no longer viewed as a force beyond the individual's control; rather, it was motivated by individual pain and pleasure. Proponents of the naturalistic school of thought posit that criminals calculate risks and rewards based on the certainty and severity of the resulting criminal punishment (Gottfredson & Hirshi, 1990). Later, positivist criminology, the forerunner of modern criminology, introduced the focus on multifactor explanations for criminal behavior. In keeping with the positivist paradigm, positivist criminology places an emphasis on biological, psychological, and sociological factors as influences for criminal behavior (Vold, Bernard, & Snipes, 2002).

The following review of social and criminological theories provides a brief overview of the nature of criminal and deviant behavior by focusing on three general areas relative to crime and delinquency: (a) psycho-sociological perspectives of criminal behavior, (b) sociological perspectives of criminal behavior, and (c) manifestations (characteristics and victimization) of criminal behavior. Rather than provide a comprehensive analysis of each theory discussed, the intention is to offer a sufficient explanation of the theory, its relevant framework, and its relationship to other schools of thought. This approach will facilitate an understanding of the relationships that connect human and social behavior with victimization and community vulnerability to crime. It will also lay the foundation for intervention through transportation. The references cited

herein provide extensive additional information for those with an interest in further exploring the details associated with these theoretical perspectives.

Psycho-Sociological Perspectives on Criminal Behavior

To understand crime and delinquency, I will begin with the human mind. Psychology, the scientific study of cognitive and affective functions and behaviors, divulges that individual thoughts, beliefs, and ideas trigger individuals to act the way they do. Psycho-sociology adds the social context to the study of psychology by examining how the social groups and circumstances within which one exists influence individual behaviors. Focusing on observable behavior, behavioral theorists study inputs and outputs; however, they cannot actually observe or examine the mental processes that relate "inputs" or stimuli to "outputs" or behaviors. Skinner (1904–1990), an American psychologist, behaviorist, author, inventor, and social philosopher, made famous the "black box" reference to these mental processes (Skinner, 1938). Skinner's "Radical Behaviorism" attempted to create a psychology based entirely on the relationships between objectively observable stimuli and objectively observable responses. Since he could not directly observe responses within the mind from the outside, Skinner labeled this cognitive processing the "black box." This observation provides a foundation for understanding individual criminal behavior from a purely psychological perspective, by linking inputs to behavioral outputs via mental process in this so-called "black box."

Origins of self and society. Several fundamental theories provide the necessary foundation for understanding the sociological influences on human behavior and the tendencies toward crime that seem most relevant to this study. In his work, *The Social Contract*, Rousseau (1762) theorizes that life in society is inherently bad when

individuals act only out of selfish desires. A truly moral society is only possible through the enforcement of a "social contract" where members of that society live according to laws that support the "general will" among them and guard against harm from others. Conforming to this general will within a society theoretically controls deviance and criminal behavior through a desire for acceptance of and accountability to the common good.

Another fundamental concept is the recognition of social origins, or group origins of "self." Cooley's (1902) *Looking Glass Self* explains both human and criminal behavior as a response to how an individual believes society sees him or her. Cooley (1902) theorizes that individuals think and act in ways that mirror how they believe others perceive them, as if it were a reflection in a mirror. He labeled this concept the "looking-glass self." Based on this idea, interactions with others help develop and shape an individual's behavior. Individuals develop their personality, form their habits, and achieve individuality by seeing themselves through the eyes of others and through the social exchange of ideas. This social self, which is unique to human beings, relies on a process of continually adapting to the perspective of others that begins in early childhood and continues as long as an individual participates in society and maintains social interaction.

In his work *Human Nature and the Social Order*, Cooley suggests the "looking glass self" involves three steps:

1. To begin, people picture their appearance of themselves, traits and personalities.
2. They then use the reactions of others to interpret how others visualize them.

3. Finally, they develop their own self-concept, based on their interpretations. Their self-concept can be enhanced or diminished by their conclusions (1902, p.152).

Cooley further explains:

> A self-idea of this sort seems to have three principal elements: the imagination of our appearance to the other person; the imagination of his judgment of that appearance, and some sort of self-feeling, such as pride or mortification (1902, p.152).

Cooley (1902) developed his self-concept after conducting extensive sociological testing of children in a controlled environment. Researchers instructed children who entered a room containing a bowl of candy to take only one piece. Unaware that they were being observed, the children took as much candy as they could. Repeating the experiment, the children were escorted to another room lined with mirrors so they could see themselves. In almost all instances, the children took only one piece of candy. Cooley determined that, by observing their own behavior in the mirrors, the children changed their behavior because they felt ashamed. He further determined that the children felt this sense of shame because the images they saw reflecting back represented how they felt society perceived them. Based on these findings, Cooley concluded that individuals shape their self-concept based on their interpretations of how others see them, defining themselves within the context of the groups in which they exist. Through symbolic interaction, individuals also realize that their actions can elicit responses from others as they shape and define themselves in the context of these social interactions. Building upon this notion of self, Cooley (1902) concluded that interactions with primary

groups (family, playgroups, neighborhoods or local community) serve as a crucial source of one's morals, sentiments, and ideals.

Self-control theory. Self-control is the internal restraint within an individual that enables them to resist the temptation to commit a crime or any other brief, self-focused indulgence based on the moral values within society. Originally developed by Gottfredson and Hirshi (1990), self-control theory posits that individuals differ in their ability to exercise restraint when given the opportunity to commit a criminal act. This theory proposes that the lack of individual self-control or restraint constitutes the main reason for criminal behavior, not simply the desire to commit a crime.

Within this framework of low self-control, the two primary causes of criminal activity are the offender's desire to commit the crime and his/her evaluation of the situation. Offenders are not concerned about the expectations and moral beliefs of others, nor are they worried about risks and the punishment that may result (Hirschi, 1969). Further, while many perceive that individual pleasure or self-gratification serves as the basis for criminal activity, the major benefit of many crimes, such as child abuse or aggravated assault, is a relief from temporary frustration. Self-control theory as a basis for criminal activity reasons that these two motivations for crime, pleasure-seeking and frustration-avoidance, reflect a lack of self-control when tempted to commit a criminal act. Self-control, or the lack thereof, provides a rational explanation for delinquent activity and criminal behavior given the following characteristics (Gottfredson & Hirshi, 1990, p. 89):

1. Satisfies desires immediately.
2. Satisfies desires without difficulty.

3. Provides excitement or thrill.
4. Long-term benefits are irrelevant.
5. No special skills or preparation are necessary.
6. Causes pain or anxiety to someone else.

Unlike other theories, research in self-control theory suggests that some criminals, such as those who commit street crimes, seldom weigh the costs and benefits associated with criminal acts and may not even be capable of doing so (Shover & Honaker, 1992). Self-control theorists consider the majority of street crimes like muggings and robberies "opportunistic," providing immediate gratification with little skills or planning required (Conklin, 1972). These findings support the characteristics of low self-control.

Rational choice theory. Rational Choice Theory (RCT) serves as a social-psychological theory based primarily on basic moral philosophy, political and legal theory, and economics (Akers & Sellers, 2012; Lilly, Cullen, & Ball, 2007). RCT supports the utilitarian perspective of the rational individual, refocusing somewhat on classical theories of human behavior where individuals pursue self-interest by avoiding pain and seeking pleasure.

RCT assumes that individuals make choices based on their fundamental desire to maximize pleasure and minimize pain (Lilly, Cullen, & Ball, 2007; Akers & Sellers, 2012). In pursuit of this objective, they decide how to behave by employing an informal cost-benefit analysis. They compare the "costs" of their individual actions with perceived "benefits." Matseuda, Kreager, & Huizinga noted that two assumptions serve as the basis for the rationale when deciding between these choices (Matseuda, Kreager, & Huizinga, 2006). First, all actions are ranked in order of preference (completeness).

Second, if Action A is preferred to Action B, and B is preferred to C, then Action A is preferred to C (transitivity) (2006).

RCT supports classical criminological theory, which provided a basic rationale for deterrence theories. Beccaria, influenced by moral reforms in the penal system during the Enlightenment, proffered that criminal laws are of the social contract introduced by Rousseau (Beccaria, 1764/1963). Through this social contract, society provides protection of individual rights to personal welfare and private property to its members. In reciprocation, they must surrender their freedom to violate the rights of others. To protect individual rights, society uses deterrence or a form of threat to potential offenders with punishment that is sufficient to outweigh the perceived benefits of crime (Lilly, Cullen, & Ball, 2007).

The notion that crime occurs as a result of rational choices and decisions was first introduced by criminologists Clarke and Cornish (1985). Their logic originated using economic models that assume individuals, criminal and non-criminal, respond to incentives and deterrents through a series of rational choices. They further argued that crimes are rational decisions committed by reasoning individuals using strategic thinking. Under this premise, crimes exist as events that primarily satisfy self-interest and are explained using the same principles used to explain all other human conduct. Based on the individual's view of the relative costs and benefits of committing an offense, a variety of individual perceptions, circumstantial considerations, and environmental constraints present each criminal opportunity and trigger criminal action (Pratt, Cullen, Blevins, Daigle, & Madensen, 2006).

Cornish and Clarke (1986) explain the assumptions of criminal thinking on which they base their book, *The Reasoning Criminal: Rational Choice Perspectives on Offending*:

> The assumption is that offenders seek to benefit themselves by their criminal behavior; that this involves the making of decisions and of choices, however rudimentary on occasion these processes might be; and that these processes exhibit a measure of rationality, albeit constrained by limits of time and ability and the availability of relevant information (p. 1).

Recent perspectives continue to expand on RCT and deterrence. For example, Becker's "expected utility" model of criminal decision-making demonstrates that individuals engage in criminal activity when the expected utility from committing crime is greater than the expected utility from not committing crime (Becker, 1968; McCarthy, 2002). Under this model, "utility" refers to both costs and rewards, and is determined by weighting the objective probability of getting caught and punished (costs) or the objective probability of getting away with it (rewards) (Becker, 1968).

Matseuda, Kraeger, and Huizinga posit that, at its core, "rational choice theory of deterrence and crime specifies that an individual will commit crime if the utility of rewards from crime (weighted by the probability of obtaining the reward) outweighs the utility of costs (weighted by the probability of being caught)" (Matseuda, Kreager, & Huizinga, 2006, p. 100). Under this more complex model of RCT, the perceived costs of crime include not only formal sanctions such as arrest, conviction, jail, or imprisonment, but also opportunity costs (opportunities forgone by virtue of crime). In keeping with

RCT, these calculated costs are largely extrinsic or external (e.g., punishment) and rarely internal (e.g., guilt, shame, remorse).

Benefits or rewards that result from crime typically refer to income as with monetary crimes or the theft and sale of stolen goods. For most crimes, however, criminological research suggests that psychic returns or thrills are also major factors in deciding to engage in criminal activity (McCarthy & Hagen, 2005). In adolescent subcultures or gangs within communities where members reward behavior that they consider "cool" or "bad ass", an individual's social status serves as a primary motivation to engage in street crime and violence (Katz, 1988). In these cases, criminals find themselves attracted to crime by its excitement or, what Katz terms, "sneaky thrills." From this perspective, RCT has similar ties with Cooley's "looking glass self" discussed earlier in this chapter. Studies on RCT and deterrence theory evince that rationality and deterrence have greater influence on instrumental crimes, such as burglary, and robbery than on expressive crimes like vandalism and disorderly conduct (Chambliss, 1967; Zimring & Hawkins, 1973).

Sociological Perspectives on Criminal Behavior.

Control theories. Control theories provide an alternative theoretical paradigm for explaining criminal and deviant behavior, differing from theories that focus on the biological, psychological, or social forces that motivate individuals to commit crime. Instead, control theories focus on why people do *not* commit crimes. It poses the question: "What controlling forces keep people from committing crimes?" According to control theorists, individuals commit crimes when restraining forces are weak, not when forces driving them to crime are strong (Vold, Bernard, & Snipes, 2002). "Crime is not a

response to unusual psychological needs or the product of a profound sense of duty. It is, rather, the product of ordinary desires operating on people ill-equipped to resist them" (Hirshi, 1977, p. 340). Control theories explore the effective control of these natural desires. They attempt to ascertain the potential restraints, circumstances, and desires that can prevent criminal behavior (Hirschi, 1969).

Hirshi states that control theories "…assert that the delinquent is relatively free of the intimate attachments, the aspirations, and the moral beliefs that bind most people to a life within the law (Hirschi, 1969, p. Preface)." He assumes that the potential for immoral or illegal conduct is present in each of us, suggesting that everyone might succumb to criminal behavior if there wasn't something preventing them from doing so. Theoretically, individuals learn and maintain moral or controlled behavior by virtue of the connections they establish and maintain with other people and institutions.

Social control & collective efficacy. Similar to self-control theory, social control suggests that criminal behavior occurs primarily due to a lack of controlling factors, rather than individual desire to commit a criminal act. It differs from self-control in that social control leads to conformity within communities where individuals form bonds as members of social groups such as family, church, and school. Conformity results when four primary control variables are present (Hirschi, 1969; Vold, Bernard, & Snipes, 2002; Lilly, Cullen, & Ball, 2007):

1. Attachment – exists when an individual feels a strong connection to others.
2. Commitment – exists when an individual shares a loyalty to conventional society and recognizes the potential loss through criminal behavior.

3. Involvement – exists when an individual participates in conventional activities.
4. Belief – exists when an individual accepts the notion of conforming with conventional rules of society.

Each of these variables represents a major social bond that satisfies the basic human need for relationships and a sense of belonging. As these social bonds increase, the level of conformity increases as well. This conformity becomes an external restraining force or social control against criminal behavior in communities where it exists.

Collective efficacy is often associated with crime and/or the lack thereof, based on the aspect of social control. Collective efficacy builds on social control, combining social bonding or cohesion among neighbors with one's willingness to engage in informal "policing" within the community. Based on this notion, the *neighborhood* is believed to be the primary venue for ensuring order in public places such as streets, sidewalks, and local parks (Sampson, Raudenbush, & Earls, 1997). Collective efficacy, however, can only occur where "cohesion and mutual trust" in the neighborhood is linked to "shared expectations for intervening in support of neighborhood social control" (Sampson & Raudenbush, 1999, pp. 611-12). In neighborhoods where socioeconomic disadvantage, immigrant concentration, and residential instability tend to produce higher levels of crime and delinquency, social control and collective efficacy can effectively reduce these effects. Examples of collective efficacy at work include community programs such as Crime Watch and other similar volunteer initiatives.

Cultural transmission and learning theories. Cultural transmission and learning theories recognize that society has conflicting norms and values. In the context of these conflicting norms and values, learning theories suggest that individuals will behave based on the norms and values they learn or acquire through their cultural affiliations. These norms and values can be conforming and traditional, or they can be deviant, producing criminal and delinquent behaviors.

Differential association. Just as social control and collective efficacy can reduce crime through social cohesion or "bonding," they can also contribute to a higher incidence of criminal activity. Individual delinquency is frequently associated with the delinquency of an individual's friends. The need for social acceptance and the neighborhood cultures that develop under differing moral frameworks provides an explanation for this relationship.

Social bonding and learning occur within cultures of all types, moral and immoral, where "boundaries" for individual behavior vary. Similar to moral traits, traits that are criminal or deviant are learned through social interaction. These subcultures of crime continue to bond, forming ties that help to rationalize on-going criminal behavior and support increased criminal activity (Gottfredson & Hirshi, 1990).

Sutherland's theory on differential association (Sutherland, 1947) builds on social control theory, adding a "learning" component. His theory proposes that individual alliances or associations are determined in the general context of our social organizations such as family, church, and community. Within these contexts, individuals learn behavior. Sutherland further explains that social groups form differently. Some groups organize in support of criminal activity while others come together to prevent this

behavior. Based on differential association theory, lawlessness would be more prevalent in areas organized for criminal activity. For many neighborhoods, this creates a culture conflict where different sub-cultures, some criminal and some conventional, compete for loyalty among the residents. Residents must then define the culture set, whether it is criminal or conventional, with which they will associate.

Sutherland bases his theory of differential association on the following nine propositions about criminal behavior (Lilly, Cullen, & Ball, 2007, pp. 42-43):

1. Criminal behavior is learned.
2. Criminal behavior is learned in interaction with other persons in the process of communication.
3. The principle of learning criminal behavior occurs within intimate personal groups.
4. When criminal behavior is learned, the learning includes (a) techniques of committing a crime, which sometimes are very complicated, sometimes are very simple; and (b) the specific directions of motives, drives, rationalizations, and attitudes.
5. The specific direction of motives and drives is learned from definitions of legal codes as favorable and unfavorable.
6. A person becomes delinquent because of an excess of definitions favorable to violation of law over definitions unfavorable to violation of law. This is the principle of differential association.
7. Differential associations may vary in frequency, variation, priority, and intensity.

8. The process of learning criminal behavior by association with criminal and anti-criminal patterns involves the mechanisms that are involved in any other learning.
9. While criminal behavior is an expression of general needs and values, it is not explained by those general needs and values since non-criminal behavior is an expression of the same needs and values.

Social learning. In general, researchers view social learning theories as one component of a larger social behavioral approach, emphasizing "reciprocal interaction between cognitive, behavioral, and environmental determinants" of human behavior (Bandura, 1977, p. vii). Social learning theory was initially introduced in the mid-1960s, integrating sociological theory (differential association) with individual conditioning and cognitively-oriented psychological (reinforcement) theories to explain criminal, deviant, and conforming behavior. Akers (1977), one of the primary advocates of social learning theory, extended Sutherland's differential association theory by reinforcing it with principles of behavior acquisition, continuation, and cessation in his theory of social learning. The principal notion of social learning theory acknowledges that learning processes exist in the context of social structure, interaction, and situation, producing both conforming and non-conforming behavior. The difference is the added emphasis on the direction and balance of the relevant influences on individual behavior (Akers & Sellers, 2012). These learning processes and their sociological influences demonstrate how individuals learn to become offenders (Akers R. L., 1977).

Akers uses a "social structure - social learning" model (SSSL) to demonstrate how social structures have an indirect effect on individual conforming and non-

conforming behavior, and ultimately, on crime rates (Akers R. L., 1998). Based on this model, which integrates macro-sociological (structural) concepts into social learning theory, Akers argues that social location exposes individuals to different learning environments, conventional as well as criminal. Consequently, social structure acts as an indirect cause of crime by introducing an individual to both normative and norm-violating alternatives. According to Akers and Sellers, four fundamental principles or variables serve as a basis for social learning theory (Akers & Sellers, 2012):

1. Differential association – individuals learn in a social context among the individuals or groups with whom they interact socially, directly or indirectly (p. 90)
2. Definitions – individuals attach attitudes and meaning to behavior, defining the behavior as right or wrong (p. 90)
3. Differential reinforcement – individuals weigh anticipated social rewards and punishments or social consequences that may result (p. 91-92)
4. Imitation –individuals engage in behavior after observing similar behavior in others (p. 93)

Integrating these four fundamental principles, social theory posits that individual deviant behavior varies depending on an individual's associations, definitions, and reinforcements, as well as their imitation of deviant models or observed behavior. Akers summarizes social learning and these four fundamental principles as follows (2011, p. 50):

> The probability that persons will engage in criminal and deviant behavior is increased, and the probability of their conforming to the norm is decreased when

they differentially associate with others who commit criminal behavior and espouse definitions favorable to it, are relatively more exposed in-person or symbolically to salient criminal /deviant models, define it as desirable or justified in a situation discriminative for the behavior, and have received in the past and anticipate in the current or future situation relatively greater reward than punishment for the behavior.

Social disorganization. Social disorganization theory provides different perspective on social and criminal behavior that is based on cultural transmission. This theory illustrates the cumulative effects of learning theories such as differential association and social learning theories within communities. Developed in response to Chicago's high crime rates in the late 1920s, social disorganization relates criminal behavior to ecological theories by linking high crime rates to ecological characteristics within communities. This theory reasons that youths from disadvantaged neighborhoods participate in a subculture in which delinquency is acceptable behavior and that they learn criminality in these social and cultural settings through social interaction. It differs from other criminological theories because of its core principle: place matters (i.e. one's residential location) as much or more than an individual's characteristics (age, gender, and race) in shaping the likelihood that he or she will become involved in illegal activities. Social disorganization theory applies primarily to street crime at the neighborhood level in particular as compared to all types of crime or deviant behavior.

Leading researchers in the area of social disorganization theory, Shaw and McKay, determined that juvenile delinquency might be better understood if you consider the social context in which youths live (Shaw & McKay, 1942). As the result of their

research on juvenile court records in the Chicago area over several decades, Shaw and McKay attributed social disorder and increased rates of crime and delinquency in communities to three fundamental factors; (a) low economic status; (b) mixed ethnical backgrounds; and (c) transiency among residents (1942).

While working for the state-supported child guidance clinic in Chicago, Shaw & McKay conducted research building on Burgess' "Concentric Zone Theory." Explaining this theory, Burgess illustrates the radial growth of cities by defining five distinct zones where businesses and residents are spatially distributed (Park, Burgess, & McKenzie, 1925; Lilly, Cullen, & Ball, 2007). The core or central business district is known as Zone 1. Zones 3, 4 and 5 are primarily residential areas, ranging from blue-collar to higher-end income commuter homes. Zone 2 exists in the area between the central business district and the residential areas. Burgess (Park, Burgess, & McKenzie, 1925 [1967]) refers to Zone 2 as the "zone in transition", and depicts it as the least desirable area of a city because of its constant state of transition and consistently higher rates of crime.

According to Shaw and McKay's findings, life in Zone 2 is of the primary cause crime. These are neighborhoods where social disorganization prevails, and supervision, common bonds, and social intimacy are absent. In this context, social disorganization theory incorporates social control and bond theories, as well as collective efficacy. Based on these theories, neighborhoods are communities made up of groups of people who share a common territory, culture, and a set of social institutions. These social institutions help provide for daily needs such as safety, shelter, food, health care, education, and employment (Sutherland E. H., 1939, 1947). This aspect of community is "place-based" and suggests that "territory," as it relates to community, is significant.

The most important aspect of community, however, is the interaction that occurs between and among residents within their territory, culture, and social institutions. An individual's well-being is just as dependent on his or her personal relationships as it is on safety, shelter, and food (Sutherland, 1939, 1947; Maslow, 1954). Because the potential for these relationships tends to vary widely from place to place or from zone to zone, the implication of individual well-being is not just a personal issue; it is a social issue. The sense of well-being originates in community influences and development. Community leaders create strong communities by facilitating interaction between and among residents and by eliminating or reducing barriers to public discourse. Through community-oriented interaction, residents strive to organize and improve local social institutions (i.e. families, churches, and schools), culture, and ecology. Through a common sense of community grounded in social organization, they influence or control the social forces that affect them most (Wilkinson, 1991).

In collaboration with several of his colleagues, Sampson researched and published extensively on social disorganization and collective efficacy (Sampson & Groves, 1989; Sampson & Raudenbush, 1997; Sampson, Raudenbush, & Earls, 1997; Sampson & Raudenbush, 1999; Sampson & Raudenbush, 2001). Empirical evidence from his research on social disorganization and collective efficacy supports and extends Shaw and McKay's concept of social disorganization. In his research with Groves, they conclude that their "…empirical analysis established that communities characterized by sparse friendship networks, unsupervised teenage peer groups, and low organizational participation had disproportionately high rates of crime and delinquency." (Sampson & Groves, 1989, p. 799)

Manifestations of Criminal Behavior

The review of psycho-sociological and sociological perspectives of criminal behavior in the foregoing section provides some rationale for why crime and delinquency exist in our communities. The theories explain why crime exists by suggesting the motivations for the behavior of criminals and delinquents, and offering insight on the influence society has on that behavior. In this section, a review of the characteristics of crime along with a discussion of opportunity theories will demonstrate how crime and delinquency evolve and unfold in neighborhoods and communities. This discussion explores characteristics and patterns of crime and delinquency and their impact on criminal opportunities within the confines of the community. This information aids in assessing areas of community exposure to criminal and delinquent behavior and targeting these opportunities for intervention.

Characteristics of crime. Most criminological theorists conclude that crime is a complex event. They articulate the following five essential and common elements: (a) law, (b) offender, (c) target and/or the victim, (d) place, and (e) time of the incident. All five elements must converge simultaneously for a crime to occur. If one or more element is missing, no criminal incident can occur (Brantingham & Brantingham, 1981 [1991]). Criminological theorists focus on combinations of these components, altering the significance of one factor over another, in order to explain criminal activity and victimization.

Gottfredson and Hirschi (1990) provide more detail on crime and criminal activity in their book, *A General Theory of Crime*. The authors focus on an overview of

crime, criminality, applications of theory, as well as research and policy. They identify the following characteristics of ordinary crime (Gottfredson & Hirshi, 1990, pp. 16-18):

- Crimes of personal violence (rape, assault & robbery) occur disproportionately at night.
- Automobiles are stolen predominantly at night.
- Personal larceny (taking property without force or threat of force) most often occurs during the day.
- Burglary occurs equally, both day and night.
- Violent crimes take place outside the home (often in streets or public areas).
- Most violent crimes (except homicide) and personal crimes are committed by strangers.
- Large cities have higher crime rates with wide variation across areas within them.
- Where household income increases, crime decreases.
- Victims and offenders of personal crime are predominantly young minority males.
- Patterns are consistent with recreational patterns of youth and inconsistent with the vocational patterns of adults; little desire to expend effort; accessibility increases risk for victims; and offenders avoid detection.
- Ordinary crime requires little in the way of effort, planning, preparation, or skill.
- Most crime occurs in close proximity to offender's residence (burglar, embezzler, robber, and so forth.).

- Offenders plan crimes only to reduce the effort required, avoid direct confrontation, or reduce resistance (weapons, right targets, and so forth.).
- The only skill required is show of superior force or command of weapons.

Viewed in context, these characteristics, as well as the five essential elements of crime, demonstrate that opportunities for criminal behavior are limited. Criminals assess the risk of a crime by considering these characteristics and elements relative to their location. The following overview of crime opportunity theories enhances this understanding of the relationship between characteristics of crime and a specific region or community.

Crime opportunity and victimization. To this point, the theoretical discussion has focused on *why* an individual commits a crime, what motivations create the desire within. Opportunity and victimization theories focus more on *how* crime is committed, what factors come together to create the opportunity or put victims at risk.

Routine activity/lifestyles theories. Routine activities theory and lifestyles theory are similar to other crime opportunity theories because they are derived from *victimization* research. They differ from other theories that emerge from *criminal* research, which are grounded largely in data on offender motivation. In contrast, crime opportunity theories build upon the premise that the offender has sufficient motivation to commit a crime. In so doing, they focus more on what puts victims at risk. Using this different perspective, routine activities and lifestyles theorists focus on criminal opportunities and the variations in behavior that provide for these opportunities.

Routine activities (RA) theory posits that daily routines and activities influence the likelihood of criminal victimization (Cohen & Felson, 1979, 1981; Felson, 1986,

1987; Miethe & Meier, 1990). This theory builds on two primary assumptions about the nature and determinants of crime. The first assumption is that predatory crimes occur when motivated offenders, suitable targets, and the absence of a capable guardian come together in same time and place (Cohen & Felson, 1979). The second assumption is that some routine activities bring greater exposure to risk than other activities. For example, frequent activity outside the home that occurs as a routine such as a job or workout schedule can increase contact with potential offenders, expose a vulnerable target, and/or reduce effective guardianship (Garofalo, 1987; Lynch, 1987; Miethe, Stafford, & Long, 1987; Sampson & Wooldredge, 1987).

Similar to other criminological theories, RA theory is rooted in environmental criminologist perspectives that reason that a criminal event consists of a willing offender and the opportunity to act on their criminal motives. Based on this perspective, Felson has identified three essential ingredients, "…a motivated offender, a suitable target, and absence of guardians" - that produce the "chemistry for crime" (Felson, 1998, p. 52). Absent any of these ingredients, a crime cannot occur. RA theory links the coming together of these three elements into the routine activities of individuals within their communities. Potential offenders have routine activities that present targets or opportunities for crime. Guardians have routine activities that expose targets to potential offenders.

The Center for Problem-Oriented Policing, a non-profit organization for law enforcement professionals, researchers, and universities organized for the advancement of problem-oriented policing, identifies and explains the relationship between and among actors, places, and tools under routine activities theory. The adaptation of a

crime triangle from the Center for Problem-Centered Policing in Figure 1 illustrates this relationship (Center for Problem-Oriented Policing, 2013). A problem analysis triangle or crime triangle provides a visual tool for understanding recurring problems of crime and disorder. Similar to the five essential elements offered by Brantingham & Brantingham (1981 [1991]), this model assumes crime occurs when likely *offenders* come together in the same *place* as suitable *targets*, without the presence of an effective *controller* (guardian, handler, manager) (Center for Problem-Oriented Policing, 2013). However, the risk of crime can be significantly reduced with the presence of one or more controllers. The effectiveness of the actors (offenders and victims) involved will depend on the tools they have available to defend or assert themselves. Adding or deleting various elements within this model will increase or decrease the chances of crime.

Figure 1. Crime triangle.

Under RA theory, the interaction of attractive targets, weak handlers, ineffective guardianship, and indifferent management are not random occurrences (Cohen & Felson, 1961). Both offenders and victims have routine behaviors and activities that create opportunities for crime. For example, offenders' activities take them away from

handlers to places where attractive targets lack effective guardians. Activities of potential victims separate them from effective guardians and take them to places with weak management. When these situations arise, opportunities for criminal behavior increase. Individual routine activities shape the opportunity aspect of crime by informing potential offenders when targets are most vulnerable, thereby influencing crime itself.

Lifestyles theory integrates similar assumptions. Hindelang, Gottfredson, and Garofalo suggest that we associate characteristics such as age, sex, race, and income, which indicate status, with role expectations that result in routine patterns of behavior or *lifestyles* (Hindelang, Gottfredson, & Garofalo, 1978). Variations in these "lifestyles" affect rates of exposure for "high risk times, places, and people" (Hindelang et al., 1978, p. 245). Therefore, individuals who have routine activities or lifestyles that place them in situations of greater risk are more inclined to experience criminal victimization. Researchers have tested these theories in a variety of cross-sectional and longitudinal studies (Cohen & Cantor, 1980, 1981; Cohen & Felson, 1979, 1981; Hough, 1987; Messner & Blau, 1987; Miethe, Stafford, & Long, 1987). The results of these studies indicate that crime rates for violence and property crimes increase where routine activities and lifestyles frequently take individuals or guardians away from their homes. These studies suggest that offenders observe the routine patterns of activities and identify opportunities for crime in response to these observations. Based on these findings, activities outside of the home such as work, school, exercise, and church expose individuals to higher risks of victimization.

Routine activities and lifestyle theories provide explanations for changes in crime rates over time, changes in the social ecology of crime, and changes in one's risk of criminal victimization. For example, since predatory crime occurs more often during the evening than during morning or daytime, individuals who engage in more activity outside the home in the evening or night will increase their chance of being victimized over time. Based on routine activities/lifestyle assumptions, the relationship between the level of guardianship and risk of victimization is strong. The influence of routine activities on crime suggests that attractive targets without capable guardians will likely lead to increased criminal activity (Cohen & Felson, 1979).

Hot spots theory. As illustrated earlier in the "crime triangle" (Figure 2-1), criminology involves a number of diverse factors. The notion of "place" and its role in influencing crime serves as a platform for "hot spots" theory (Weisburd & McEwen, 1997; Weisburd, Morris, & Groff, 2009). During the early nineteenth century, European criminology theorists began to study the notion of "place," continuing this research for more than a century. Hot spots theory originated from studies conducted by sociologists working with the Chicago School of Sociology (Park, Burgess, & McKenzie, 1925; Shaw, Zorbaugh, McKay, & Cottrell, 1929; Shaw & McKay, 1942; Thrasher, 1927). The studies analyzed the distribution of crime relative to place, by focusing on how crime varies across communities. The research results demonstrate that crime-prone areas exist within communities where "hot spots" for deviant or criminal activity emerge. As early as 1751, law enforcement specialists began to recognize that increasing police efforts in these crime-prone locations deters offenders (Fielding, [1751] 1975). In the early 1900s, officials labeled crime-prone areas such as gambling houses and saloons "nuisance

locations" and targeted them for preventative policing (Fuld, [1909] 1971). In the 1960s, August Vollmer, the first Police Chief for the City of Berkley and Professor of Police Administration at the University of California, developed a system for classifying crime risk that included three parts (Wilson O. W., 1963):

1. Victims that are prone to crime (tourists, individuals who are alone, women)
2. Property that is prone to crime (vacant buildings, convenience stores, and nightclubs)
3. Locations that present higher risks of crime (concerts or political rallies)

Hot spots theory assumes that areas where crime is elevated are not random, but are more likely a response to economic, political, sociological, and environmental factors in the community. The theory suggests that these areas of elevated crime form patterns of "hot spot" concentrations that increase the likelihood of criminal activities. These tend to be environments where a greater motivation to commit crimes exists due to ongoing socio-economic conflict or undesirable environmental conditions that contribute to criminal behavior (Felson, 1998; Brantingham & Brantingham, 1981).

Hot spots theory resulted in a number of significant findings. In a 1989 study, Lawrence Sherman, founder of evidence-based policing, and his associates discovered that fifty percent of the calls to the Minneapolis Police Department during the study year originated from three percent of the addresses and intersections within the City (Sherman, Gartin, & Buerger, 1989). Sherman and his associates also noted that hot spots are not specific to any type of crime and can attract a variety of different crimes to the same locale. Law enforcement agencies continued to test this theory by targeting hot spots, including drug market hot spots, for intervention throughout the nineteen nineties

(Weisburd, Green, Gajewski, & Bellucci, 1994; Green, 1995; 1996). In addition, policing hot spots for gun violence was also explored (McEwen & Taxman, 1995; Sherman & Rogan, 1995; Kennedy, Piehl, & Braga, 1996).

Hot spots theory relates to social disorganization, social control, and collective efficacy in its focus on the context of crime and the opportunities that it avails to potential offenders. This potential relationship between social ecology and concentrations of criminal activity has generated interest in research on criminology since the mid-nineteen eighties (Taylor, Gottfredson, & Brower, 1984; Smith, Glave, & Davison, 2000; Morenoff, Sampson, & Raudenbush, 2001; Jobes, Barclay, Weinand, & Donnermeyer, 2004). In Britain, studies on "situational crime prevention" began to challenge the traditional view of offenders and communities, adding the roles that crime situations and opportunities also play in the development of crime (Clarke & Cornish, 1983; Clarke R. V., 1983).

Areas where concentrations of crime exist tend to be "hot" only during certain times; therefore, "hot spots" go together with "burning times," creating clusters of crimes in different dimensions of space *and* time (Wood D. , 1991). The commission of a crime is "... very much a matter of knowing where to go, just as ... knowing when to do it" (Wood, 1991, p. 91). To this end, research has shown that the combination of place and time between vulnerable targets and potential offenders increases the likelihood of victimization (Cohen & Felson, 1979). Similar research on suburban burglary by Rengart and Wasilchick (1985) suggest that the nature of crime in a given place is also dependent on certain times when crime is most prevalent, since most areas have certain hours or

days when they are free of crime. In addition to the potential daily and weekly variations, seasonal variations can influence crime as well (Sutherland, 1947).

New techniques such as metric topology, a combination of math and topography, and the introduction of new technologies such as geographical information systems (GIS) have improved the ability to analyze crime relative to time and space (Grubesic & Mack, 2008). These new approaches provide more effective alternatives to traditional hot-spot analysis, provide more accurate monitoring and analysis of hot spots over time, and enable criminologists to analyze the various aspects of crime both separately and together.

Broken windows theory. Social scientists Wilson and Kelling expanded on earlier theories of community/social disorganization, offering their alternative "broken windows" theory. Emerging from studies on juvenile delinquency (Park, Burgess, & McKenzie, 1925; Shaw & McKay, 1942), social disorganization theories propose that the neighborhood environment and culture trigger crime (Lilly, Cullen, & Ball, 2007). The broken windows hypothesis focuses on the norm-setting and signaling effects of urban disorder and vandalism, explaining that increased crime rates in communities stem from a "failure to fix broken windows" (Wilson & Kelling, 1982).

Other researchers have reached similar conclusions. "Levels of non-criminal decay and social disruption can spawn more serious problems in the future by undermining the capacity of communities to respond to crime" (Skogan & Lurigio, 1992, p. 525). This theory not only explains typical neighborhood crimes, but also behavior associated with riots and looting such as those that occurred in New Orleans as communities were reeling from the effects of Hurricane Katrina and in Baltimore

following the riots over racism and police discrimination. During events like these, looting and rioting routinely occur and have become an anticipated response to events involving social disorder.

Wilson and Kelling (1982) began their logic in formulating broken windows theory by focusing first on public fear, or "the fear of being bothered by disorderly people" (pp. 29-30). They proposed that public disorder in and of itself serves as a source of fear. Additionally, they observed that broken windows and other signs of neglect send a message to offenders that no one cares about the property or that the property has no guardian. As the Center for Problem-Oriented Policing illustrates in the Crime Triangle (Fig 2-1), the lack of a guardian constitutes one of the contributing factors in the production of crime. Just as a broken window on a house sends a message of neglect, neighborhoods that show public signs of neglect and social disorganization send a similar message. These signs include social "incivilities" that range from physical signs like unkempt public areas and graffiti to behavioral signs for activities such as loitering and drunkenness.

Wilson & Kelling's broken windows theory defines and clarifies the two types of incivilities, physical and social. Ralph B. Taylor, Ph.D., Professor, Department of Criminal Justice, Temple University distinguishes these incivilities in his National Institute of Justice article entitled *Crime, Grime, Fear, and Decline* (1999, p. 1):

> Examples of social incivilities include public drinking or drunkenness, rowdy and unsupervised teen groups, sexual harassment on the street, arguing or fighting among neighbors, open prostitution, and—since the mid-1980s—public drug sales and the presence of crack addicts. Physical incivilities include abandoned

> buildings, graffiti, litter, vacant and trash-filled lots, unkempt yards and housing exteriors, abandoned cars, and—again, since the mid-1980s—the conversion of houses and apartments to drug-selling locations.

According to broken windows theory, physical and social disorder set the stage for fear. Fear, in turn, makes individuals want to stay in their homes where they feel safer. Physical and social disorder sends a signal to criminals that "no one cares." Unless law enforcement confronts low levels of disorder and deviance, serious crimes will likely increase. Ignoring signs of disorder in communities (broken windows, abandoned lots, loitering, public drinking and homelessness), physical and social disorder will spread and crime will continue to escalate (Wilson & Kelling, 1982). This process will ultimately break down the existing system of informal social controls that regulate social interaction. Eventually, crime will proliferate and fear of crime will overcome the community.

Consequently, broken windows theory suggests that prevention of petty offenses that disrupt social order will reduce fear, increase community confidence, and discourage serious crime. Given this premise, police agencies can be more effective by including *disorder* control and by targeting minor problems as a deliberate strategic measure to prevent crime and community decline (Kelling & Bratton, 1998; Skogan, 1990). Empirical analyses also supports theories that aggressive enforcement of minor offenses will lead to a reduction in the number and frequency of more serious crime (Worrall, 2006).

Wilson & Kelling also provide empirical evidence that closely links disorder and crime (Wilson & Kelling, 1982). This fundamental relationship between disorder and

crime suggests that crime results from the physical and moral deterioration within a community. Further, this relationship suggests that fixing broken windows might be the best approach for law enforcement and communities in preventing more windows from being broken.

Many professionals in the law enforcement community believe that minor problems serve as a prelude to serious crime. In response to a recent homicide in Harrisburg, PA in July 2014, one resident described the deplorable housing conditions tolerated by absentee landlords by saying "This kind of situation breeds crime!" (Johnson J. A., 2014). Consequently, there is more support for strategies targeting minor problems in an effort to reduce the risk of more serious crime (Bratton W. , 1996; 1998; Silverman, 1999). Kelling and Coles (1996) reason that effective policing in our communities should not only address the indicators of criminality; more importantly, it should eliminate the causes of criminality by altering the social conditions that create fear, foster crime, and deteriorate neighborhoods (Xu, Fiedler, & Flaming, 2005). Focusing on this broader goal will help communities maintain a safe environment, where the basic social institutions of family, church, school, and so forth can operate effectively and thrive (Kelling & Coles, 1996).

Adaptations of broken windows theory emphasize a broader context, supporting the need for prioritization of "order maintenance" in relation to community or "quality-of-life" policing. Modified versions of broken windows policing focus on reducing social and physical disorder while adapting a less aggressive style of policing (Katz, Webb, & Schaefer, 2001). These strategies assume that reducing signs of disorder will motivate community members to work together to improve their neighborhoods and

promote safety. The underlying theme is that communities that work together to reduce disorder will send a signal that crime is not welcome.

During the late 1990's, Mayor Rudy Giuliano took an aggressive stand on cleaning up New York City (NYC) streets. In so doing, NYC based much of its clean-up efforts on quality-of-life policing policies. NYC adopted former New York Police Department (NYPD) Commissioner, William Bratton's "Zero Tolerance Policing" (ZTP) in 1994 (Bratton & Knobler, 1998). Upon his appointment to serve as New York City's police commissioner in 1994, Bratton targeted crime throughout NYC and reduced serious crime rates by 33% in just over two years, Bratton's success was widely known as NYC's quality of life improved. Based on NYPD crime data available, Bratton and Knobler (1998) credit quality-of-life policing for this success.

Strategies based on disorder policing have experienced criticism as well. In his research examining the costs and merits of aggressive order-maintenance policies, Howell (2009) uses NYC's experience to argue that aggressive policing of misdemeanor and lesser offenses has drawbacks as well. He concludes that "the impact of aggressive policing of minor offenses on crime rates requires more study," and goes on to add "the costs associated with policing order via the criminal justice system are so great that immediate steps must be taken to reduce them" (Howell, 2009, p. 271). He further argues that the loss of legitimacy and diminished economic opportunities resulting from aggressive order-maintenance policing may result in increases in crime and disorder. Despite the debate on the implementation of order-maintenance policing, research on broken windows theory effectively links disorder to higher rates of crime.

Situational Crime Prevention

Opportunity theories suggest that psycho-sociological and sociological factors are not the only contributing factors of crime. According to the aforementioned characteristics of crime and opportunity theories, crime results in significant part because of the opportunities presented by the physical environment. Building upon this belief, criminologist C. Ray Jeffrey claims that it is possible to alter the physical environment so that crime is less likely to occur (Jeffrey C. R., 1971).

Situational Crime Prevention (SCP) considers these determinants, identifying operational and environmental changes that minimize the opportunity for crime. This approach to crime prevention builds upon the premise that most offending results from the deliberate choices made by individuals. By focusing on settings for crime and predicting the occurrence of crime, officials can curb crime by making criminal action less attractive (Jeffrey C. R., 1971).

SCP is defined as "the use of measures directed at highly specific forms of crime which involve the management, design or manipulation of the immediate environment in which these crimes occur, so as to reduce the opportunities for these crimes" (Hough, Clarke, & Mayhew, 1980, p. I). It involves preventative strategies that encourage local authorities, businesses, property owners, and residents to employ practical deterrents, reducing the risk that buildings, public spaces, and people will become criminal targets. SCP focuses on the causal influence of situational and environmental factors rooted in Routine Activity Theory and Rational Choice Theory, and assumes that the motivation for crime is a given (Clarke & Felson, 1993). Under SCP, the focus is broader, considering in more detail "the manner in which the spatio-temporal organization of

social activities helps people translate their criminal inclinations into action" (Cohen & Felson, 1979, p. 592). SCP aims to understand and predict how the three core elements of crime come together; and then to reduce the opportunities for crime in specific locations or hot spots.

Crime Prevention Through Environmental Design (CPTED)

The concepts of place-based crime prevention emerged during the early nineteen seventies. Expanding on SPC strategies, these strategies became generally known as Crime Prevention through Environmental Design (CPTED). In his book, *Crime Prevention through Environmental Design*, Jeffery (1971) contends that sociologists place too much emphasis on the social causes of crime, and overlook the importance of biological and environmental determinants. He introduces the idea of environmental "controls" of behavior using science and technology, urban planning, systems analysis, and decision analysis to prevent criminal and delinquent behavior. Similarly, Newman (1972) acknowledges the crime-inhibiting qualities of architectural design through the formation and arrangement of urban housing. Based on notions founded in rational choice theory, these efforts make criminal activity less attractive to offenders, thereby deterring criminal behavior.

CPTED influences the physical design of redevelopment projects in city centers and older suburban areas. These approaches to planning continue to gain support throughout the United States, evincing results in effectively reducing crime. CPTED's five key principles aim to increase public safety and to promote a sense of physical security (Crowe, 2000; Jeffrey, 1971; Newman, 1972, pp. 9-10):

1. Natural Surveillance – “eyes on the street”; allows people to see their surroundings from inside or outside
2. Territorial Reinforcement – provides a welcoming or unwelcoming feeling depending on the intended user. (public space, semi-public space, and private space)
3. Building Design – aides in positive visibility (visible entrances, windows, gathering spaces, building placement, interior design, landscaping, parking lots, and so forth)
4. Lighting – exterior site lighting, public lighting, and roadway lighting
5. Social interaction – creating places for social interaction

A 2003 Field Action Report on a project completed in Sarasota, Florida noted improvements in several measures of crime attributable to CPTED-related measures (Carter, Carter, & Dannenberg, 2003). Incorporating CPTED principles, Sarasota planning officials called for installing and maintaining outside lighting for building entrances, walkways, and parking lots. They also ensured that designs for landscaping included ground cover and canopy trees to provide sufficient visibility, demonstrate guardianship, and enhance the pedestrian and recreational areas. These CPTED principles discourage illegal behavior and make the environment more comfortable for legitimate behavior. Among the key findings, the authors conclude, “Crime Prevention through Environmental Design principles incorporated into land use regulations provide a basis for developing and redeveloping a safe and attractive built environment over time, thereby having a long-term positive impact upon community health (Carter, Carter, & Dannenberg, 2003, p. 1443).”

In cities like Sarasota, community crime prevention requires a comprehensive approach. CPTED principles can be a significant contributor to an overarching strategy. Carter et al. (2003) conclude, "The experience in Sarasota highlights the impact of the built environment on crime and the importance of a comprehensive approach for designing, implementing, and evaluating interventions that may improve the health of a community (Carter, Carter, & Dannenberg, 2003, p. 1445)."

More recent policy initiatives also acknowledge the influences that the built environment has on social ecology. Smart Growth and New Urbanism improve neighborhood environments by emphasizing their physical aspects. These new urban design movements emerged during the 1980's, focusing on urban form, land use, transportation, and housing choices. They originated from the belief that the suburban model that evolved in the 1940's and 1950's cannot be sustained for future generations (Agnew, 2001; Katz, 1994). While incorporating concepts that address crime as of these larger urban initiatives, their broader focus is on addressing many of the problems associated with the current urban sprawl development pattern. By studying the formation of close-knit communities, they demonstrate the attendant positive social bonding and collective efficacy that results.

Transportation and the Built Environment

Transportation represents a central part of every community. Transportation infrastructure requires a large footprint among other neighborhood structures, and its maintenance places significant demands on communities. Transportation provides easy access to and from communities for work, shopping, leisure, and so on, which improves economies and expands opportunities for residents.

Streets and community. While streets are an essential part of a community's physical infrastructure, they also serve as an important social aspect of our communities. They represent public places where social interaction occurs regularly. This social interaction takes place between and among individuals of all types, delinquents and/or non-delinquents, depending on the culture of the community. Within this culture, control of public streets can vary from delinquent (gangs) to non-delinquent (recreation, open markets, and community watch programs), ranging anywhere in between. Based on these critical aspects, transportation can have ripple effects, positive and negative, within our communities.

Jane Jacobs, an American-Canadian writer and activist who studied communities and urban planning, recognized the social importance of streets and sidewalks in communities. She saw them as critical contributions to the perceptions of order and safety within communities (Jacobs, 1961):

> Streets serve many purposes besides carrying vehicles, and city sidewalks - the pedestrian part of the streets - serve many purposes besides carrying pedestrians. These uses are bound up with circulation but are not identical with it and in their own right they are at least as basic as circulation to the proper workings of cities. (p. 29)

As an advocate for city streets as an integral part of our public spaces, Jacobs' view is unique. "Streets and their sidewalks, the main public places of a city, are its most vital organs" (Jacobs, 1961, p. 29). From this perspective, streets serve as the primary visual scenes for residents and visitors. "Think of a city and what comes to mind?" she

asks. "If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull" (Jacobs, 1961, p. 29).

Within communities, the streets and sidewalks provide for increased mobility. Mobility, however, also depends on perceptions of order and safety. Jacobs explains, "When people say that a city … is dangerous or a jungle, what they mean primarily is that they do not feel safe on the sidewalks" (Jacobs, 1961, p. 30). The belief that order and safety exist is dependent on perceptions concerning the variety of activities that transpire in these public places. When evidence of visual order exists, such as proper maintenance, visual appeal, and a sense of guardianship, people feel safer. According to Jacobs, "sidewalks and those who use them are not passive beneficiaries of safety or helpless victims of danger. Sidewalks, their bordering uses, and their users, are active participants in the drama of civilization versus barbarism in cities" (1961, p. 30). Therefore, aesthetic norms play a critical role in safeguarding order and safety within our communities (Jacobs, 1961, p. 30):

> Today barbarism has taken over many city streets, or people fear it has, which comes to much the same thing in the end … It does not take many incidents of violence on a city street, or in city district, to make people fear the streets. As they fear them, they use them less, which make the streets still more unsafe.

In addition to order and safety, Jacobs recognizes the important role that sidewalks play in providing for social contact and assimilation of children. By encouraging social contact between strangers, sidewalks help to create healthy communities and guard against social ills that lead to urban disorder. "Sidewalk public contact and sidewalk public safety, taken together bear directly on our country's most

serious social problem—segregation and racial discrimination" (Jacobs, 1961, p. 71). Recognizing that people in the streets serve as a natural surveillance, Jacobs also suggests that the more people are inclined to socialize in public, the more we can reduce opportunities for crime and disorder (Jacobs, 1961). As the cycle of perceptions of safety and order continue, more people are attracted to these public spaces, therefore communities may actually become safer. In contrast, in communities that are perceived to be unsafe, people spend less and less time in public, relationships dissolve and mistrust builds, leading to a state of chaos, and disorder (Jacobs, 1961).

As suggested by Jacobs (1961), the physical or built environment in which one lives shapes and influences communities as much as the people who live in them. Criticizing the professional planning community, she blames urban disorder and decline on poor design and planning. She demands that society conceptualize and reconstruct its communities, strengthening informal social controls and one's sense of "community" (Jacobs, 1961). Community leaders should carefully consider city planning and zoning for healthy, productive, safe, and sustainable cities.

Complete streets. Today's transportation policy makers recognize the contributions that transportation provides within communities. In their book, "Rethinking Streets: An Evidence-Based Guide to 25 Complete Street Transformations" Dr. Marc Schlossberg et al. note, "No public space works harder than the street. Streets provide vital links to homes and business, and serve as public spaces (Schlossberg, Rowell, Amos, & Sanford, 2013, p. 3)." Yet, over time the automobile shifted the focus our streets from public spaces to auto thoroughfares. The "Complete Streets" initiative is attempting to reverse this paradigm, emphasizing the broader applications for these

public spaces in a tradeoff that can provide substantial benefits for communities (Schlossberg, Rowell, Amos, & Sanford, 2013).

In "Rethinking Streets," the authors highlight 25 street transformations from across the country aimed at reclaiming these public spaces. The improvements include traffic calming, pedestrian & bike lanes, street-scaping, and more. Success was based on traffic, safety, and economic measures, whereas crime was not specifically considered. Each of these projects reported key outcomes ranging from reduced speeds, decline in traffic, increased bicycle & pedestrian traffic, increased safety (through reduced crashes), improved street life, positive public perception, economic growth, and increased property values. Only one community, West Palm Beach, FL, noted a reduction in crime as one of their key outcomes (Schlossberg, Rowell, Amos, & Sanford, 2013, p. 80).

Federal & state policy initiatives. The Federal Highway Administration (FHWA) and the PennDOT have implemented a number of programs that support livable communities (Livability Initiative, 2012). Funded with federal transportation dollars, these programs make transportation the central focus of specific initiatives identified within FHWA's program guidance. Specifically, community-focused initiatives emphasize the importance of making roads safer for all users; encouraging walking and bicycling; helping communities make decisions about transportation and land use for improved access and mobility; and encouraging businesses to contribute to quality of life via investment in the built environment, culture, and philanthropy. While several initiatives address issues not central to this research (air quality, driver behavior, freight movement, and so forth), others clearly support efforts to improve the life of the

community. Accordingly, they influence social behaviors such as crime and delinquency. Examples of federal and state level programs include:

Context Sensitive Solutions (CSS). This collaborative, interdisciplinary approach for developing transportation projects incorporates context sensitive solutions principles, such as traffic calming and sound walls, in all aspects of planning and the project development to improve the environmental quality of transportation decision-making. CSS constitutes a process designed to involve all stakeholders from community members and interest groups to elected officials and government agencies. CSS represents a product that results in transportation infrastructure that preserves and enhances scenic, aesthetic, historic, community, and environmental resources. Similarly, CSS also improves safety, mobility, and infrastructure conditions (Federal Highway Administration, 2014).

Exemplary Human Environment Initiatives (EHEI). This Program recognizes and publicizes transportation initiatives that make the transportation infrastructure work better for the people who use it by (Federal Highway Administration, 2014):

- Encouraging people to be more physically active in their modes of travel;
- Making changes to the transportation infrastructure;
- Improving how we plan and implement changes to transportation processes;
- Educating people about the benefits of human-centered transportation;
- Using technology in creative ways; or
- More cross cutting issues

Transportation Enhancements (TE) Program. The TE Program provides funding to enhance the transportation experience. In doing so, it encourages

municipalities to submit projects that provide people with a better quality of life. Using TE funding, communities incorporate social, cultural, aesthetic, and environmental benefits at the same time that they compete for community projects involving pedestrian and bicycle infrastructure, landscaping and scenic beautification, environmental mitigation, and the like. This program was recently replaced by the Transportation Alternative Program (TAP) (Federal Highway Administration, 2014).

Home Town Streets. This Pennsylvania Department of Transportation (PennDOT) program promotes a variety of streetscape improvements in order to reestablish downtown and commercial centers. Selected projects include sidewalk improvements, planters, benches, street lighting, pedestrian crossings, transit bus shelters, traffic calming, bicycle amenities, kiosks, signage and other visual elements. The projects enhance the downtown environment and promote interactions with people in the area. PennDOT recently consolidated this program with other programs under the Transportation Alternatives Program (TAP). (PennDOT Center for Program Development & Management, 2014).

Safe Routes to School. This PennDOT program provides funding for physical improvements designed to facilitate safe walking and biking passages to community schools. This program also merged with other programs under the Transportation Alternatives Program (TAP). (PennDOT Center for Program Development & Management, 2014)

All of the aforementioned social policies show the ongoing emergence of transportation into systems that directly relate to social constructs. The policies highlight the fact that transportation plays a larger role in one's communities than simply enabling

the movement of people and goods from place to place. In this capacity, transportation adds to and detracts from neighborhood quality of life as of the built environment.

Transportation and Law Enforcement

In addition to recognizing transportation's general contributions within our communities, transportation and law enforcement professionals have started linking transportation with criminal behavior. The U. S. Department of Transportation's (DOT) National Highway Traffic Safety Administration, along with the Bureau of Justice Assistance and the National Institute of Justice (both within the United States Department of Justice), sponsor a national program to improve the quality of life in local communities. Data-Driven Approaches to Crime and Traffic Safety (DDACTS) serves as a law enforcement operational model that uses location-based crime and traffic data to locate "hot spots" for crime, crashes, and traffic violations (National Highway Traffic Safety Administration, n.d.). Through geo-mapping of convergent crime and crash data, DDACTS informs law enforcement agencies about the most effective and efficient methods for deploying law enforcement and other resources (National Highway Traffic Safety Administration, 2009). Recognizing that high incidences for both of these activities are frequently co-located, law enforcement agencies are working to be more strategic in addressing both issues with the findings under this initiative.

DDACTS introduces several new ideas concerning deterrence activities. More significantly, it links crime and transportation by engaging communities to play the dual role of fighting crime and of reducing crashes and traffic violations (National Highway Traffic Safety Administration, 2009). Under this initiative, traffic enforcement becomes a highly visible deterrent for a variety of crimes (National Highway Traffic Safety

Administration, 2009). In addition, the knowledge that crimes often involve the use of motor vehicles provides reason to analyze crash and traffic violation activity and their relationship to street crimes. Finally, DDACTS utilizes community-oriented law enforcement (National Highway Traffic Safety Administration, 2009). Community-oriented law enforcement incorporates time- and place-based policing in lieu of traditional person-based policing. Law-enforcement professional believe this new approach is "… more efficient in the focus of law enforcement actions; provides a more stable target for law enforcement activities; has a stronger evidence base; and raises fewer ethical and legal problems" (National Highway Traffic Safety Administration, 2009, p. i).

Although research such as that behind the DDACTS initiative clearly links law enforcement and transportation, it differs substantially from research that directly focuses on transportation's influence on criminal behavior, which forms the focus of this study. DDACTS uses crime and crash data to foster better decisions relative to the deployment of law enforcement resources, which enables decision-makers to identify where to deploy resources. By contrast, the study at hand more closely follows Jacobs' thinking with its focus on the direct interplay between transportation infrastructure design and criminal behavior. This study rests on the concept that effectively designed infrastructure deters criminal behavior and thereby assists in law enforcement. This potential reduction in law enforcement resources will foster probable reallocations of scarce resources for deployment in other local government venues.

Synthesized Theory

Crime theory enhances our understanding of why and how crime and delinquency occur. Information about the built environment and community guide our understanding of the overall context in which social behavior, deviant or conforming, responds to it. Based on this understanding, community leaders can design or alter this built environment to intervene with the idea of reducing crime and delinquency.

Theoretical Framework

The Theoretical Framework in Figure 2 illustrates the interplay among the crime theories described in this chapter, and provides a synthesis that serves as the basis for this study.

As observed in this figure, the psycho-sociological theories of self, self-control, and rational choice provide insight on the psychological triggers within the "black box" that frequently lead to criminal behavior. Understanding motivation or desire to commit crime serves as pre-theoretical background, and sets the stage for understanding community-based crime and delinquency.

Adding external influences through social interaction, crime and delinquency take on a sociological perspective as well. Social influences affect individual behavior as well as the likelihood that crime will occur. Social learning, social control, differential association, and cultural transmission are among the external sociological influences that lead individuals to conforming or non-conforming/deviant behavior. While individuals ultimately choose whether to commit a crime or not, they also experience influences stemming from their individual psychological desires and frustrations, and by external influences emanating from the social structure in which they exist. This social structure

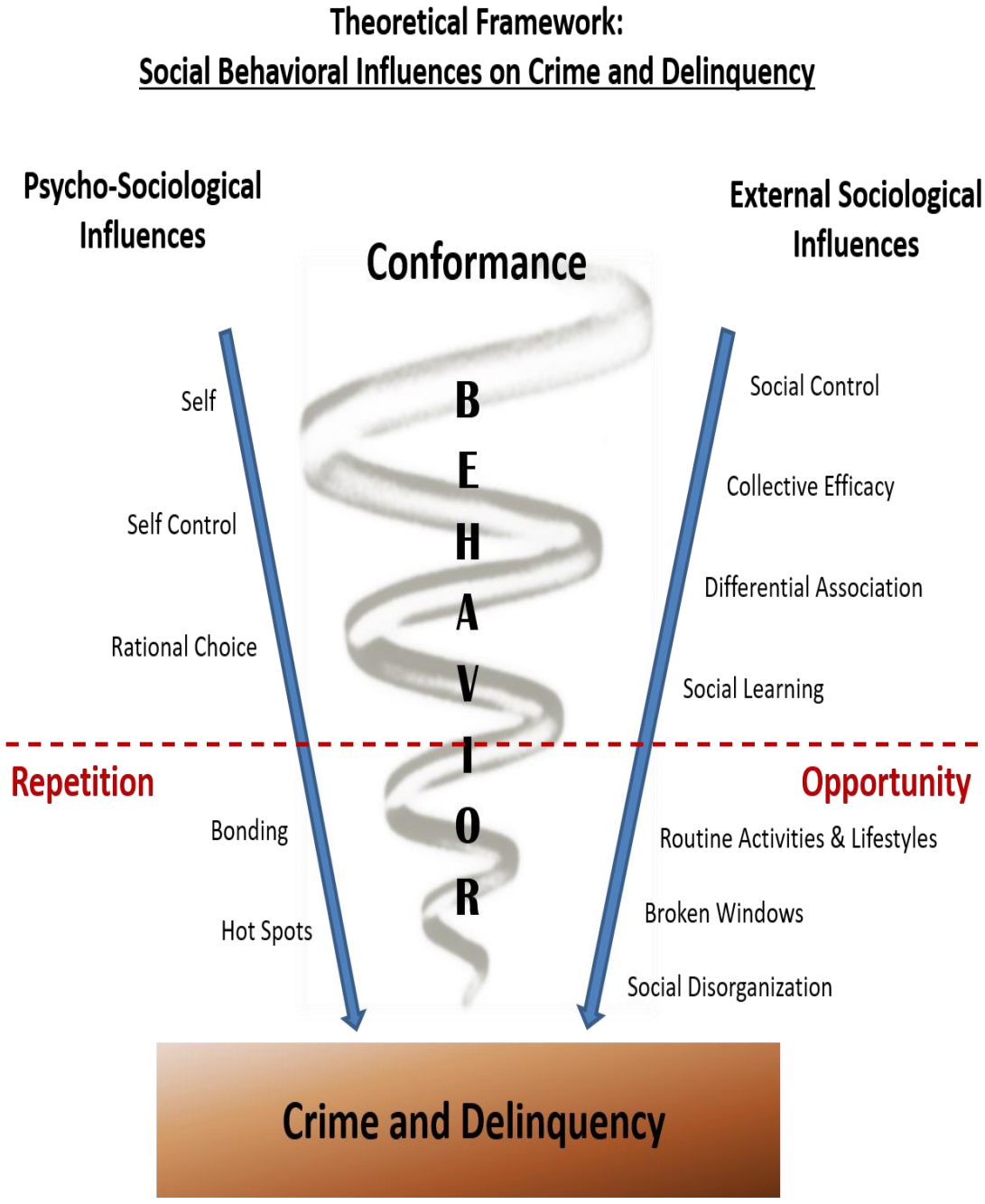

Figure 2. Theoretical framework of synthesized theory.

serves as an effective "guardian" (or reinforcement in terms of gangs) through social control, and through cultural transmission "teaches" individuals to act in a deviant or non-deviant manner. Individuals learn behaviors – deviant as well as non-deviant – and

the associated risks or rewards through social interaction. Social control and differential association reinforce this learning through social bonds.

Observation and learning in the social context influences crime in other ways. Observation and social learning among deviants strengthens bonds and builds support for delinquent behavior. Learning from others, deviants identify criminal opportunities through routine activities and lifestyles that leave targets vulnerable. Where encouragement of this behavior perpetuates, "hot spots" of criminal activity become evident. As this cycle continues, crime increases, fear and neglect take over, and "broken windows" result from the lack of an effective or caring guardian. This cycle of continual social learning, support, and encouragement leads to social control and increased bonding among deviants, thereby further perpetuating this behavior. It ultimately manifests itself in a culture of crime and delinquency. In this social ecology, many non-deviants become passively submissive or choose to relocate, contributing further to social disorganization and increased criminal activity.

One way to reduce criminal activity is for communities to intervene in a permanent way and break the learning cycle among deviants. They must *disorganize* the existing deviant organizations and provide support for non-deviant behavior. Crime occurs where a motivated offender and a suitable target come together in the same place without an effective controller (manager, handler, or guardian). Most criminological theories support the basic notion that intervention at this intersection of offender and target through an effective controller reduces the likelihood that crime will occur by removing the opportunity to commit the crime. For example, policing criminal "hot spots" reduces crime through strategically placed handlers (police). Similarly, increasing

security over vulnerable targets provides effective guardianship and reduces the risk of theft or vandalism. Finally, fixing broken windows and other signs of neglect conveys the message that a place is managed effectively.

Table 1 provides a different view of this theoretical framework within which the various theories and perspectives connect. The framework begins using a social ecology lens and illustrates how each theory manifests itself according to the community's level of social organization. First, sociological theories of rational choice, self-control, and social learning unfold differently in communities where social disorganization exists. At their root, these theories support concepts of self, social self, and basic human needs. Depending on the characteristics of social organization that make up the social ecology, these needs are met in significantly differing ways. On the one hand, social bonds make individuals feel accepted; therefore, the risk of losing this acceptance is far greater than the short-lived benefits of criminal activity. On the other hand, social disorganization results in a disconnected environment where "self" becomes primary and individuals realize social acceptance through gangs.

Considering opportunity and victimization perspectives, communities with social organization tendencies look vastly different from those where social disorganization prevails. Social organization provides for guardianship and collective efficacy, discouraging criminal behavior, where social disorganization lacks this structure and shows signs of disregard.

If community leaders simply perceive the role of transportation infrastructure as limited to the movement of people and goods within each of these ecologies, it becomes

difficult to link this infrastructure to changes in criminal behavior. However, recognizing the role of transportation infrastructure in healthy sustainable, communities suggests its

Table 1

Theoretical Framework Relative to Social Ecology

Theoretical Perspectives		Social Ecology Social Organization	Social Disorganization
Sociological	Rational Choice	Social bonding support moral character Individual & collective guardianship are apparent Choose collective efficacy	Choices are self-focused Opportunities for criminal activity persist
	Self-control	Individual self-control exists as a result of social control and bonding Constructive social learning takes place	Low self-control exists due to lack of social control and low morale Perceptions of careless minimize perceived risks for offenders
	Social Learning	Social structure influences behavior (family, school, church, community) Conforming behavior	Social acceptance motivates behavior (friends, gangs, community) Non-conforming behavior
Opportunity/ Victimization	Routine Activities/Lifestyles	Social institutions present and active - Churches - Schools - Businesses Neighborhood watch programs Public contact and interaction Attention to community	Transient behavior Limited public contact and interaction Busy schedules prevent time for community Apparent patterns of inattentiveness Carelessness in carrying out routine activities
	Hot Spots (and Burning times)	Minimized due to lack of opportunities for criminal activity Informal moral social control reduces criminal activity	Prevalent throughout community Informal immoral social control increases criminal activity Requires vigilance to control criminal activity
	Broken Windows	Fix problems areas as they arise Minimize public disorder Visible appearance of caretaker	Degradation persists Public disorder tolerated No appearance of caretaker
Transportation	CPTED & Livable community initiatives	Focus on built environment and it's community influence Target areas for criminal activity Features provide for public contact and interaction Well-maintained to show guardianship Healthy options for transportation Access encourages and supports community institutions Creates pride among residents	Transportation focus limited to moving people and goods Neglected asset Poorly maintained
Results		**Healthy, sustainable communities**	**Delinquency and crime**

potential for serving as an effective intervention that can break the cycle spiraling and leading to social disorganization, delinquency, and crime.

Conceptual Framework

The built environment within our communities can serve as a viable physical intervention for crime. Through research in place-based crime prevention, urban planners now effectively incorporate environmental "controls" intended to prevent criminal and delinquent behavior (Carter, Carter, & Dannenberg, 2003; Duany & Speck, 2010; Jeffrey C. R., 1971). Given the belief that transportation infrastructure operates as an essential part of this built environment, it represents a potential physical intervention for criminal deterrence if designed and built with this in mind. The Concept Map illustrated in Figure 3 illustrates the directionality of deviance in relation to social intervention.

Communities with characteristics of social disorganization have much higher levels of deviance than communities that do not. Social intervention can act to reduce this level of deviance; however, the cost and complexity will likely depend on the level of deviance a community faces. Transportation, as a function of the built environment, may also serve well among these interventions. Henceforth, a natural tension exists between increasing deviance and increasing social interventions. Increased deviance follows a downward spiral toward disorganization while social intervention leads toward and maintains strong communities. The role of transportation infrastructure as a social intervention may address deviance by interceding between opportunity and the criminal act. By observing and measuring criminal behaviors and preventative guardians, a

community can determine its depth along the spiral. The more a community exhibits characteristics of social disorganization, the more expensive the social intervention.

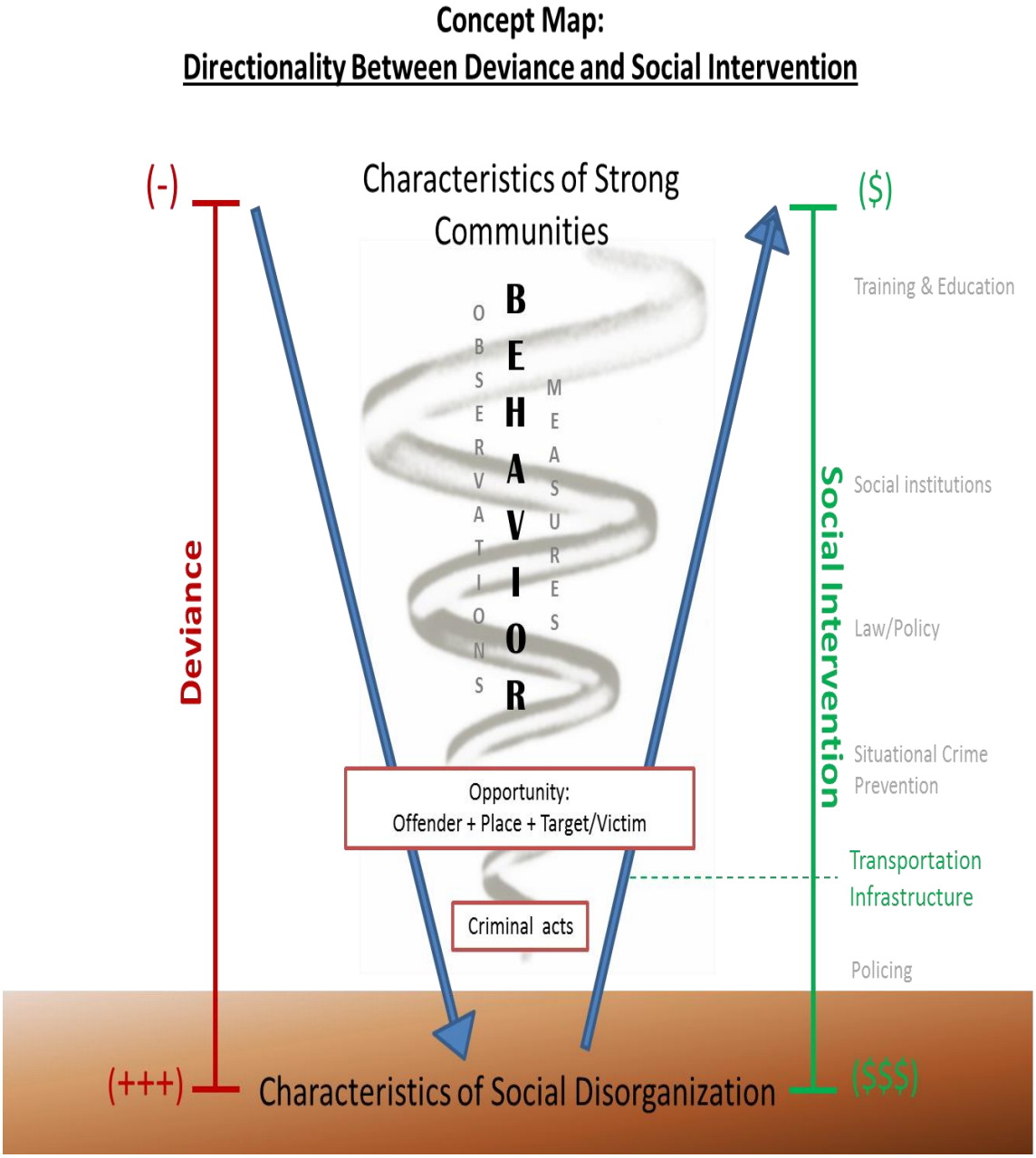

Figure 3. Conceptual map addressing the tension between deviance and social intervention within a community.

Transportation Infrastructure as an Intervention

Social theories show the on-going emergence of transportation into systems that directly relate to social constructs. Based on this relationship, transportation may play a larger role in our communities than simply allowing for movement of people and goods from place to place. In this capacity, transportation can add to and detract from our neighborhood quality of life as an integral part of our built environment. In addition, transportation infrastructure may provide potential deterrents for criminal activity provided a community properly designs, constructs, and maintains it. To become influential and to strengthen communities against crime, these deterrents must address the opportunistic nature of crime as well as motivation of the offender, and encourage social bonding and collective efficacy.

While demands for community funding pose challenges, funding for transportation remains available. PA's Liquid Fuels Tax Municipal Allocation Law, Act 655, (Pennsylvania General Assembly, 1956) provides for the allocation of PA's Liquid Fuels Tax funds to municipalities for transportation projects on an annual basis. This Act also governs the use of these funds by municipalities and appoints PennDOT as the regulatory authority for their administration. PennDOT's Bureau of Municipal Services oversees the administration of these funds and publishes policies and procedures to guide recipients on acceptable expenditures (Bureau of Municipal Services, 2014, pp. 2-3). Within these guidelines, municipalities use these funds for a variety of transportation improvements within their communities. Table 2 lists the acceptable expenditures for the use of Liquid Fuels Funds under PA law (Pennsylvania General Assembly, 2014, pp. 1-3 & 1-4).

Table 2

Acceptable Expenditures for Liquid Fuels Funds in Pennsylvania

	Acceptable Expenditures:
1	Construction, reconstruction, maintenance, and repair of public roads or streets
2	Acquisition, maintenance, repairs, and operation of traffic control devices (signs, signals and control systems, pavement markings, and so forth)
3	Electricity for signals and streetlights
4	New products for low volume local roads
5	Debris removal from the roadway and its gutters and shoulders
6	Road materials
7	Brush removal to improve sight distance
8	Engineering fees
9	Guiderail and pipe
10	Traffic calming activities
11	Traffic and engineering studies
12	Curb ramps

In addition to Municipal Liquid Fuels Funding, municipalities compete for federal transportation funds. The US DOT is poised to move toward a more balanced transportation system, recognizing the need for more than just asphalt, concrete and steel. In 1991, the US DOT disbursed the first funding dedicated to "transportation enhancements" and continues to do so through the federal acts of legislation noted in Table 3 (Center for Program Development and Management, Pennsylvania Department of Transportation, 2014):

Table 3

Federal Transportation Legislation

Year	Transportation Legislation
1991	Intermodal Surface Transportation Efficiency Act: ISTEA
1999	The Transportation Equity Act for the 21st Century: TEA-21
2003	The Transportation Equity Act for the 21st Century Continuing Resolutions: TEA-21-CR
2005	The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users: SAFETEA-LU
2013	Moving Ahead for Progress in the 21st Century: MAP-21

In February of 2014, under MAP-21 above, the Federal Highway Administration (FHWA) consolidated local programs such as the Transportation Enhancements (TE) and the Safe Routes to School Program, into one comprehensive program, the Transportation

Alternatives Program or TAP (Federal Highway Administration, 2014). The TAP provides transportation funding for community projects through a federal cost share combination providing 80% federal funds with a 20% state or local contribution. Eligible projects under this newly consolidated program are listed in Table 4 (Federal Highway Administration, 2014).

Table 4

Eligible Projects for TAP Funding.

	Eligible projects under the Transportation Alternatives Program (TAP)
1	Bicycle and Pedestrian Facilities
2	Bicycle and Pedestrian Education (K-8)
3	Conversion of Abandoned Railway Corridors to Trails
4	Construction of Turnouts, Overlooks, and Viewing Areas
5	Outdoor Advertising Management
6	Historic Preservation and Rehab of Historic Transportation Facilities
7	Vegetation Management
8	Archaeological Activities
9	Stormwater Management
10	Wildlife Mortality Mitigation

While the consolidated program still makes additional transportation funding available to municipalities, the wider variety of programs will generate more competition for the limited supply. In addition, the programs listed above indicate a reduced emphasis on the downtown enhancement initiatives of former programs, suggesting tighter budgets for these kinds of projects. Linking reductions in crime and delinquency to transportation infrastructure provides ample justification to set projects apart from others in this competitive arena. Consideration of transportation infrastructure's potential for reduction of criminal behavior may also help guide municipal officials as they plan for expenditures of their annual Liquid Fuels Allocation, selecting projects with multiple benefits and designing attributes into projects that might otherwise have been ignored.

Purpose of the Study

The purpose of this study is to determine if a relationship between criminal behavior and transportation infrastructure exists in such a way that transportation infrastructure can provide an effective intervention for reducing crime and delinquency. The first objective involves determining if transportation infrastructure projects have the potential to intervene and deter crime. The second objective involves measuring the impact of this intervention relative to other elements that influence crime and delinquency.

Research Questions

Based on these objectives, this study aims to determine if transportation infrastructure can serve as a viable social intervention that improves quality of life while addressing transportation needs and deterring crime within a community. Does transportation infrastructure have an effect on criminal behavior within communities? If so, does this effect differ between serious crimes (I) and non-serious crimes and misdemeanors (2)? Can transportation infrastructure serve as a viable social intervention that deters criminal behavior within communities while addressing transportation needs? Can criminal opportunities or "hot spots" be limited or removed through improved designs for transportation infrastructure? Do transportation infrastructure improvements improve a community's sense of security or guardianship, which can have an indirect relationship on crime?

In response to these questions, I have hypothesized that communities that implement transportation infrastructure improvements to improve traffic flow, visibility, and general aesthetics within the community will experience overall reductions in street

crime (assaults, robbery, larceny/theft, auto theft, vagrancy, vandalism, etc.) versus communities that have not implemented such improvements. Differences in the intensity of transportation infrastructure project activity and its level of deterrence or intervention will be explored through the analysis in Chapter 4 and determined among the findings of this study. Further, I hypothesize that a community's sense of safety and guardianship will improve in response to these transportation improvement projects.

Chapter Summary

This chapter presented a review of the psycho-sociological and the sociological theories that inform researchers on the nature of crime. These theories provide the backdrop for understanding why crime and delinquency occur, from the initial, individual decision to commit a crime to the full manifestation of crime overtaking a community. Both psychological and sociological influences can serve to encourage or discourage deviance and criminal behavior. If these influences can both encourage and discourage deviance, then effective interventions are possible if properly identified and implemented.

The discussion later moves to how crime occurs, noting the characteristics of crime and criminal opportunity theories. Pointing to the five essential elements of crime: (1) law, (2) offender, (3) target and/or the victim, (4) place, and (5) time of the incident (Brantingham & Brantingham, 1981 [1991]), it is clear that criminal behavior cannot persist absent any one of these elements. Social interventions can intercept crime by manipulating one or more of these elements. These can range from educating potential offenders, to guarding potential targets through collective efficacy or policing, to eliminating places where crime can occur through environmental design and the built environment.

Building on environmental design and its influence on criminal behavior, the discussion focused on situational crime prevention and the potential role that transportation infrastructure may play as of the built environment. If transportation infrastructure can effectively serve as an intervention and contribute to crime reduction, then public funds dedicated to transportation projects may yield additional benefits by addressing both crime and transportation.

Chapter 3 will provide a review of the research methods used for this study. This discussion outlines the overall methodology, including validity and reliability, and ethical considerations. Additionally, the discussion identifies and defines the study variables and explains in detail the approaches used for sampling, data collection, and analysis.

CHAPTER III

METHODS

The purpose of this study is to explore the influence of transportation infrastructure on criminal behavior in an effort to identify ways for communities to stretch available public resources. This chapter describes the research methods used to address the questions and study objectives introduced in Chapters 1 and 2. This discussion focuses on the particulars of the research methodology; unit of analysis; sampling frame, design, and size; variables (and their definitions—independent, dependent, and control); data collection; and instrumentalities used for data collection. It also contains a discourse about the validity and reliability, including strengths and weaknesses, as well as ethical considerations and the approach to data analysis.

Research Methodology

The purpose of this study is to determine whether transportation infrastructure constitutes an effective intervention for reducing crime and delinquency in communities. In so doing, the research methodology includes two basic objectives. The first is to determine whether transportation infrastructure projects have the potential to intervene and deter crime. The second objective is to measure the impact of this intervention relative to other factors that influence crime and delinquency. The research questions that gave rise to this study's objectives follow:

1. Does transportation infrastructure have an effect on criminal behavior within communities?
2. If so, does this effect differ between serious crimes (I) and non-serious crimes and misdemeanors (II)?

3. Can transportation infrastructure serve as a viable social intervention that deters criminal behavior within communities while addressing transportation needs?
4. Can criminal opportunities or "hot spots" be limited or removed through improved designs for transportation infrastructure?
5. Do transportation infrastructure improvements improve a community's sense of security or guardianship, which can have an indirect relationship on crime?

Research Hypotheses

Based on these research questions, the following hypotheses frame the primary focus of this study:

- Hypothesis 1: Controlling for specific demographic characteristics (e.g., population, median income, etc.), communities with higher transportation infrastructure improvement activity will experience reductions in reported Part 1 crimes compared to communities that have lower levels of transportation infrastructure improvement activity.
- Hypothesis 2: Controlling for specific demographic characteristics (e.g., population, median income, etc.), communities with higher transportation infrastructure improvement activity will experience reductions in reported Part 2 crimes compared to communities that have lower levels of transportation infrastructure improvement activity.

In addition to the primary hypotheses noted above, a series of secondary hypotheses are of interest in this study. These hypotheses relate to the effect that

improved transportation infrastructure has on a community's sense of security and guardianship. The following secondary hypotheses reflect these questions as they relate to this study. I will explore these secondary hypotheses as of the case study phase of this research:

- Hypothesis 3: Improvements in transportation infrastructure have a positive effect on how individuals feel about security in their community.
- Hypothesis 4: Improvements in transportation infrastructure have a positive effect on how individuals feel about guardianship in their community.

Overview of Research Design

To address these questions and test these hypotheses, I used a sequential explanatory mixed methods approach that combines an initial quantitative analysis followed by qualitative data collection and analysis (Terrell, 2012). A sequential explanatory design emphasizes quantitative analysis, using qualitative analysis to further explain the quantitative results (Creswell & Plano Clark, 2011). The first phase of this study involves a statewide quantitative post-only correlational design using cross-sectional data to provide an overview of criminal activity relative to the implementation of transportation infrastructure projects. Following this statewide analysis, a case study phase focuses on the effects of a specific transportation infrastructure project within a single borough. I further divided this case study phase into two parts. Part A employs secondary data obtained from police reports within the borough. This quantitative data includes reports of criminal offenses within the borough over a five-year period. In addition, I also evaluated reports on complaints and incidents. Part B focuses on this same borough, but uses qualitative data gathered through a series of interviews with

businesses, police, public works employees, and emergency responders five years after the transportation infrastructure project was completed.

Using a sequential explanatory mixed-methods design, this study provides an initial quantitative analysis to investigate the relationship between crime and transportation infrastructure improvements on a statewide level where municipality is the unit of analysis. I then triangulated the data by comparing these findings with the findings obtained from a case study of a single borough, using qualitative data to further evaluate and explore this relationship. This mixed-methods approach also helped to determine whether these improvements relate to changes in criminal activity and, if so, how.

The statewide quantitative analysis uses a post-only correlational design (Judd & Kenny, 1981, p. 180). This design is similar to a nonequivalent control group design except that a pretreatment measure is not available. Based on this design, all cases receive different treatments, transportation infrastructure project activity, for purposes of this study. This statewide analysis examines secondary quantitative criminal data from Pennsylvania boroughs across the state to evaluate patterns and variations in criminal and deviant activity relative to project density, a measure of transportation infrastructure activity within communities, between 2005 and 2010. To facilitate this effort, I used data gathered through the Pennsylvania Uniform Crime Reporting (UCR) System to analyze the effects of transportation infrastructure projects on crime and delinquency in boroughs where these projects were implemented during the study period. Using a measure of project density, I then compared the crime data with data from boroughs with similar project density measures to evaluate the effect of transportation infrastructure on crime.

The statewide analysis essentially compares boroughs where substantive transportation infrastructure projects were implemented (treatment) with those that had no such projects implemented during the study period based on a measure of "project density." This variable is further explained in Chapter 4. To determine infrastructure project activity, I identified substantive transportation infrastructure projects that meet the requirements authorized under the Liquid Fuels Tax Act for Pennsylvania's municipalities (Bureau of Municipal Services, 2011). Based on the scope and complexity of these projects, the study uses a six-year window to ensure project completion and to ensure a reasonable representative sample of boroughs. During this six-year period, approximately 30% of the 958 boroughs completed eligible projects and the remaining 70% did not. Criteria on transportation infrastructure project complexity were used to identify the types of projects that have the potential to reduce crime. These criteria are discussed under variable definitions and measures later in this chapter and serve as the measure for defining substantive transportation infrastructure projects in contrast to other transportation projects.

The case study enhances the interpretation of the findings in the statewide analysis. The focus of this case study is one municipality. Part A of the case study examines quantitative crime data for this municipality collected for the same six-year period. This case study analysis breaks down the criminal activity into more specific types of crime, and includes data on incidents and complaints to evaluate variations more closely.

Qualitative data in Part B of the case study provides individual perspectives on the effects of transportation infrastructure changes in their community using qualitative

data I collected via a series of direct interviews with police officers, municipal public works employees, and business owners within the case study community. The statewide analysis and the case study phases of this study dovetail together by providing a statewide overview coupled with local perceptions on the relationship between transportation infrastructure and criminal activity.

Unit of Analysis and Sample

This study focuses on community-based crime and delinquency rather than other types of crime such as corporate or international crime. These community-based crimes make up Part 1 and Part 2 offenses as noted in Table 3-2 under the discussion below, in the section Variable Definitions and Measures. Similar to community-based crime, transportation infrastructure within these communities operates as a local issue. In Pennsylvania, these communities include nearly 2,600 municipalities ranging from boroughs to townships to cities. These political subdivisions of the Commonwealth of Pennsylvania operate in conformance with applicable state and federal regulations on the use of funding dedicated to transportation.

This study is limited geographically to the Commonwealth of Pennsylvania where information regarding transportation infrastructure projects reflects similar standards. While each municipality in Pennsylvania has its own unique issues relative to transportation and crime, boroughs are the municipal entities that provide an ideal focal point for Phase I of this study. They are small and more manageable compared to larger cities that have many more factors to consider and are therefore much more complex. Pennsylvania's boroughs are concentrated and urban-like, resembling small cities in many ways. Most boroughs are less than a square mile with a central hub or main street.

By contrast, townships reflect typical sprawl growth with intermittent stretches of residential developments, strip malls, and industrial parks. Because of the central hub and smaller scale, boroughs tend to provide a better-suited sample for preliminary analysis concerning transportation decisions and their impact on crime and delinquency. Therefore, Pennsylvania boroughs serve as the unit of analysis for the statewide analysis phase of this study.

The case study phase of this study employs quantitative as well as qualitative data in a single borough that specifically designed a transportation infrastructure project to deter criminal activity. Part A provides an analysis of quantitative data on arrests, incidents, and complaints within the borough during the study period. For Part B, I collected qualitative data through interviews with employees and business owners within the borough. For purposes of this study, the unit of analysis for Part A is the Borough of Penbrook. The unit of analysis for Part B of this case study is individual.

Sampling Frame, Design, and Size

The target population for the statewide analysis phase of this study includes all nine hundred and fifty-eight (958) boroughs within Pennsylvania. Figure 4, Pennsylvania Boroughs, 2013, (Center for Rural Pennsylvania, 2013) shows the locations and populations for these boroughs. Population estimates are based on information obtained by the Center for Rural Pennsylvania from the U.S. Census Bureau. The sample population is the same as the target populations, consisting of 956 PA boroughs. Given that this complete sample represents all boroughs whether or not they implemented transportation infrastructure projects within the prescribed study period, findings from

this quantitative phase are more generalizable as compared with a smaller representative sample.

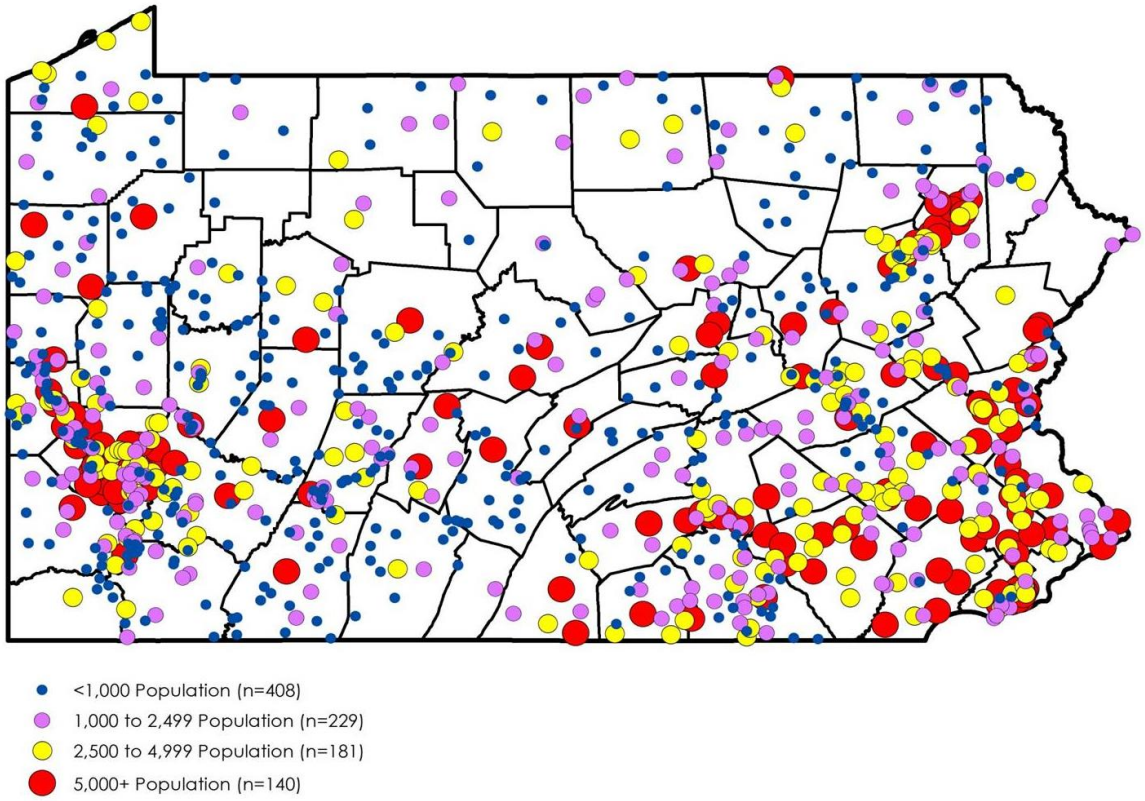

Figure 4. Map of Pennsylvania boroughs, 2013.

Limiting the sample population to boroughs within Pennsylvania ensures consistency in transportation infrastructure policies and practices at the state level. This 2005-2010 study period also limits the projects to those completed within a single administration under one governor. Keeping with this timeframe reduces the impact of changes in policies designed to reduce crime implemented under later administrations. Information concerning completed transportation infrastructure projects in boroughs was obtained from PennDOT's Bureau of Municipal Services.

The case study phase of this research focuses more narrowly on a single case where a specific transportation infrastructure project was implemented and completed

during the study period. The Borough of Penbrook was selected as the venue for the study based on a recently completed transportation improvement project where decision-makers specifically identified the reduction of criminal activity as a potential factor/result during the initial approval phase of the project. This sampling method represents a convenience sample where the sample was selected for convenience. Because this nonprobability sampling method was, by nature, unable to afford all boroughs in the population an equal chance of being selected, the results of the qualitative analysis were not used to generalize about the entire population, but to enhance the findings from the quantitative phase of the study.

Within the Borough, purposeful sampling provided the basis for selection of participants for the interviews in Part B of the case study. Using specific criteria, four interview panels comprised of groups of individuals emerged as uniquely qualified because of their occupation, expertise, and employment period. One panel included police officers and supervisors. A second panel included municipal employees and managers in the Public Works Department. The third targeted business owners in the community. All three panels represented individuals employed or involved in a community business before and after the transportation infrastructure project was completed.

Mode of Data Collection

Data collection for this study involved a mix of primary and secondary data. Secondary data were utilized for the statewide analysis. Borough demographic data were obtained electronically from the Center for Rural Pennsylvania Municipality Profiles Web page (The Center for Rural Pennsylvania, 2014). Data on borough transportation

infrastructure projects between 2005 and 2010 were collected from the Bureau of Municipal Services historical project files. Crime data for Pennsylvania boroughs were obtained from the Pennsylvania Uniform Crime Reporting System, which houses data reported by local law enforcement agencies.

The case study included data collected from two separate sources. Part A used secondary crime data reported by the Penbrook Police Department. To supplement the information gathered in the statewide analysis, and to further explore perception regarding the effects of the transportation infrastructure project on crime in the borough, I collected primary data in Part B of the case study. During this phase, direct interviews were conducted with law enforcement personnel, emergency responders, public works/municipal employees, and business owners who worked in the Borough before and after the project completion. The interviews were conducted one-on-one at the site of employment for each participant. Interviews followed a format of structured and open-ended questions (Appendix A). The use of open-ended questions generated additional unstructured questions based on the interviewees' responses, experience, and willingness to participate.

Interview Design Overview

The interview design process in Part B addressed three main components: (a) researcher relationship with the interview participants, (b) site and participant selection, and (c) data collection. While site/participant selection and data collection constitute obvious critical elements in the interview process, relationships with those who are studied proved equally important. These "gatekeepers" could either facilitate or obstruct the study depending on their perception of me, the situation, and the purpose of the study.

These relationships served as the means by which qualitative research was effectuated and, therefore, how the interviewer initiates and develops these relationships were instrumental to the design of the interview process (Maxwell, 2013).

Site and participant selection proved straightforward. For Police and Public Works Departments, the current manager was asked for a list of the employees who have worked for the agency since 2004 (pre-project). Based on this list, permission was subsequently obtained to contact these employees for purposes of one-on-one interviews regarding the respondents' perceptions about the community during the last decade. I conducted interviews with those who agreed to participate in an on-site meeting room during business hours to facilitate access with minimal inconvenience. The business owners selected were identified by the Penbrook Borough Police Chief based on his knowledge of their presence before, during, and after the project completion. It was important to ensure that all interviewees were familiar with borough activities prior to the project as well as after its completion to be able to provide feedback on any changes they perceived. All interview sessions were conducted at the owner's place of business to facilitate access and to minimize disruption in their work schedule.

The third component in the design process was data collection. I conducted each one-on-one interview in a private meeting room or location. In most cases, I collected data from the interviews using a laptop computer with a spreadsheet prepopulated with questions and that included room for responses. Space for additional comments was also included to allow for additional questions and responses which might arise during the interviews. In one instance, the setting was not conducive to the use of a laptop

computer. Where that occurred, I recorded handwritten notes and later transcribed the data into the interview spreadsheet for thematic analysis.

Design of Interview Instrument

Development of the interview instrument (Open-Ended Interview Guide) required the identification of key constructs to guide the overall format of the interviews. I identified these constructs through the literature search and review of the available data. Subsequently, I organized these key constructs in a topic map to ensure that they were effectively addressed in the process. Figure 5 represents a topic map that served as a means for developing a series of structured and open-ended questions to draw accounts from individual participants regarding changes they perceived. This Topic Map also enabled me to coordinate responses across three separate panels. Capturing the unique perspectives of these panels provided the opportunity for triangulation of the data to reduce the risk of bias or limitations.

The interview format included a series of structured open-ended questions with ratings on certain topics to help clarify the responses. In addition, probes facilitated further questioning as needed, where needed to ensure that I accurately understood and captured each individual perception. An Interview Guide and Questions, along with the full-scale version of the Topic Map, are included as Appendix A – Interview Instrument.

To practice using the interview instrument, and to test the cognitive understanding of the selected questions, this instrument was pre-tested on three individuals who did not participate in the study. Based upon feedback from these individuals as well as observations during the practice interviews, revisions to the interview guide were incorporated into the final instrument.

Topic Map:
Transportation Infrastructure & Crime

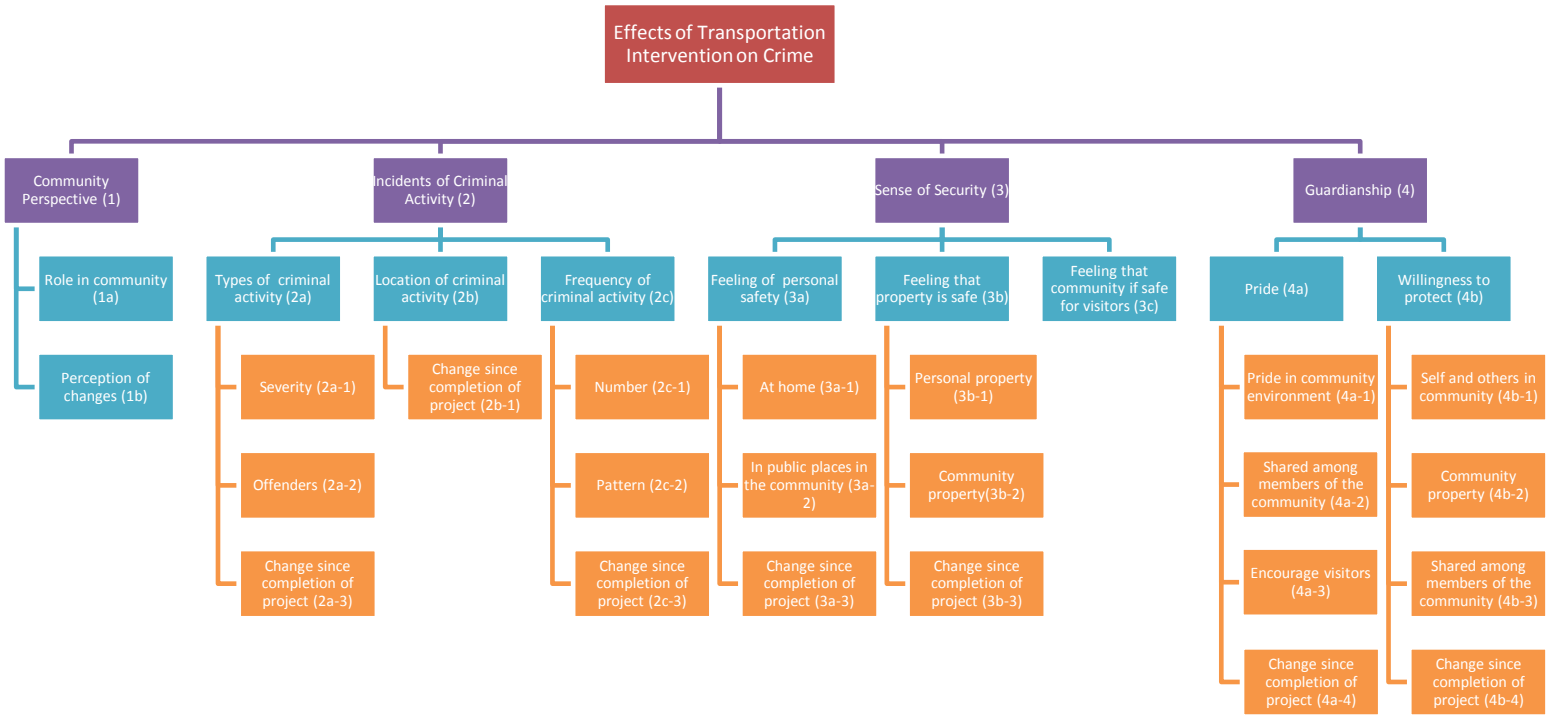

Figure 5. Research topic map.

Variable Definitions and Measures

Dependent and Exploratory Variables

Crime, Parts I and II, serve as the dependent variables for this study. I hypothesized that they would vary with the independent variable. The median number of reported criminal offenses for each borough collected as part of the statewide quantitative analysis served as the measure for this variable.

Criminal offenses in Pennsylvania divide into two parts: Part 1 Offenses and Part 2 Offenses (Pennsylvania Commission on Crime and Delinquency (PCCD), 2014). As noted in Table 3-1, Part 1 Offenses are those considered the most serious of crimes that police attend to and occur with sufficient frequency to warrant a separate classification. They are commonly referred to as "index crimes" because they routinely occur in all parts of the country and are likely to be reported to the police. To this end, they can be monitored over time to inform specialists on crime trends. Part 2 Offenses are all other offenses not defined under Part 1. Table 5 also illustrates the types of criminal offenses identified as dependent variables under this crime type.

In addition, three exploratory variables were measured as part of the structured interviews in Part B of the case study to help reinforce the qualitative data.

Crime Location refers to "hot spots" or crime-prone areas where crime and delinquency are elevated relative to other parts of the community. This variable was measured by perceived change in the number of hot spots within the community and was collected in Part B of the case study. Respondents were asked to rate their perspectives from 1-5 where 5 equals "number of hot spots has considerably declined," and 1 equals "number of hot spots has considerably increased" following the project completion.

Table 5

Types of Reported Criminal Offenses

Types of Reported Criminal Offenses	
Part 1 Offenses (U.S. Department of Justice, Federal Bureau of Investigation, 2014):	
Crime Type	**Description**
Aggravated assault	Unlawful attack by one person on another, usually with the use of a weapon, for the purpose of inflicting serious bodily injury.
Arson	Willful or malicious burning or attempt to burn, with or without intent to defraud, a dwelling house, public building, motor vehicle or aircraft, or personal property of another.
Burglary	Unlawful, often forcible entry of a structure to commit a felony or theft.
Larceny/Theft	Unlawful taking, carrying, leading, or riding away of property from the possession of another.
Motor Vehicle Theft	Theft or attempted theft of a motor vehicle.
Murder/Nonnegligent Manslaughter	Intentional or willful killing of one human being by another.
Rape	Sexual intercourse with another by forcible compulsion, threat of forcible compulsion, or with someone who is unconscious, unaware, or suffers from a mental disability.
Robbery	Taking or attempting to take anything of value from the care, custody, or control of a person(s) by force or threat of force or violence and/or by putting the victim in fear.
Part 2 Offenses (Pennsylvania General Assembly, 2012):	
Crime Type	**Description**
Assault	When an individual attempts to cause, or intentionally, knowingly, or recklessly causes bodily injury to another or cause fear of imminent bodily injury.
Disorderly Conduct	Intent to cause public inconvenience, annoyance, or alarm, or recklessly creating a risk thereof.
Drug Sale/Manufacture/ Possession	Unlawful sale, manufacture, and/or possession of a controlled substance.
Drunkenness	When a person appears in any public place under the influence of alcohol such that he may endanger himself, others, property, or become a nuisance to those in his vicinity.
Prostitution & Commercialized Vice	When an individual who resides in a house of prostitution or otherwise engages in sexual activity for business, or who loiters in or within view of any public place for the purpose of being hired to engage in sexual activity.
Sex Offenses	Sexual offenses other than rape such as indecent assault and indecent exposure.
Vagrancy	Loitering by individuals who are with no visible means of support or residence while they are still able to work.
Vandalism	When an individual intentionally or recklessly defaces, marks, or otherwise damages the real or tangible personal property of another.
Weapons	Those offenses where an individual, except where authorized by law, makes, repairs, sells, or otherwise deals in, uses, or possesses any offensive weapon.

Sense of Security refers to the perception that individuals and property are safe from crime. Respondents were asked to rate their perspectives regarding variations in their sense of security in Part B of the case study. Responses ranged from 5, "I feel our community much more secure" to 1, "I feel our community is much less secure" following completion of the project.

Guardianship reflects the collective feeling of pride and desire among members of the community to protect their community from harm. Respondents were asked to rate their perspectives regarding guardianship in Part B of the case study. First, respondents were asked to rate pride in their community ranging from 5, "My sense of pride has increased considerably as a result of the project" to 1, "My sense of pride has decreased considerably as a result of the project". Next, respondents were asked to rate the impact of the transportation infrastructure project ranging from 5, "The transportation project considerably increased our desire protect our community" to 1 "The transportation project considerably decreased our desire protect our community."

Independent Variables

Predictor variable. Project density, a measure of transportation infrastructure project activity, serves as the independent (predictor) variable in the statewide quantitative analysis. I developed this measure as a variable since the study hypothesizes that transportation infrastructure can influence crime in communities. This measure reflects the number of eligible transportation infrastructure projects that were completed during the study period based on their complexity. Only boroughs that completed major projects during the study received project density values greater than zero. These project density values increased as their transportation infrastructure project

activity increased. Table 6 shows the criterion relative to transportation infrastructure projects that determine complexity and define the project as substantive for this study.

Table 6

Transportation Infrastructure Project Complexity.

Transportation Infrastructure Project Complexity		
Feature	**Minor**	**Major**
Cost	Up to $18,999	$18,900 +
Duration	0-6 months/cyclical	6-18 months
Key Project Elements	Maintenance & repair Storm Sewers & Drains (cleaning & repair) Guiderail and pipe	Construction & Rebuilding projects Traffic Control Devices Street Lighting Traffic calming activities Curbs & curb ramps

The established procurement threshold requirement for advertising and soliciting bids served as the basis for determining minor versus major project cost. Minor projects were those completed within one construction season or occurring on a cyclical basis. Major projects were considered substantive to this study and included those that extended beyond one season. Project complexity was determined using key project elements along with subjective reasoning that considered variances in project type and scale. For example, traffic control devices such as line painting or speed indicators tend to be less complex than the installation of traffic lights or speed bumps. Additionally, projects incorporating combinations of these elements are viewed as more complex than those lacking multiple features.

Control variables. To control for variations among the boroughs, I used the Borough demographic data as control variables in the statewide quantitative analysis phase. Table 7 identifies the pertinent demographic characteristics that may have an effect on crime irrespective of other factors. These variables were statistically controlled in the analysis of the quantitative data.

Table 7

Borough Demographics.

Borough Demographics	
Variable:	**Description:**
Population Density	Number of persons per square mile within the borough
Youth Population	Number of young persons living within the borough
Unemployment	Average percent of population reported as unemployed
Age	Median age of the population
Education	Percent of population 25 and older with no high school diploma or GED.
Per capita Income	Average annual income per person
Poverty	Percentage of the population living at or below the poverty level

Reliability and Validity

This study has two major components, the quantitative look at Pennsylvania boroughs statewide, and case study analysis of the Borough of Penbrook. The case study is presented into two sub-parts. Part A is the more detailed quantitative analysis of the case study borough, and Part B is the qualitative analysis for the case study. Each offers a different perspective on reliability and validity. Reliability refers to the consistency of the scores produced and interdependency of items. Validity refers to the appropriateness of the test that was used and its ability to accurately measure what it claims to measure.

All of the quantitative data used in statewide analysis phase of this study was obtained from secondary sources. The sources represent government agencies with sufficient expertise and experience in gathering and managing crime and demographic data over time with internal processes that standardized data collection. Standardization strengthens all five types of reliability: (1) stability, (2) equivalence, (3) equivalence and stability, (4) internal consistency, and (5) scorer/rater (Gay, Mills, & Airasian, 2009). In practice, this standardization strengthened stability, internal consistency, and scorer/rater reliability. This expertise, experience, standardization, and consistency ensured that the

data source was credible, and the data was both valid and reliable by this reporting nature.

Internal and external validity for this research were carefully evaluated. In The statewide quantitative analysis segment, the primary threat to internal validity is history. Since post-only correlational design encompasses a period of six years in total, unexpected events may have occurred between beginning of the study period and the end of the study period influencing the dependent variables. While this may have occurred in some of the communities sampled, it is unlikely that such an event occurred statewide. To some degree, I controlled for this threat by limiting the study period to a single administration.

Differential selection of participants in the statewide analysis also represents a threat to internal validity. The boroughs included in the study were not randomly assigned project density measures. This assignment was based on whether a transportation infrastructure project was completed within their jurisdiction between 2005 and 2010. Characteristics that enabled municipalities to implement these projects differ from those that did not. These characteristics, therefore, may also affect the dependent variable differently. The use of control variables focused on borough demographics enabled further testing for these variances.

Threats to external validity with regard to the quantitative data used in the statewide quantitative analysis proved minimal given the ability to collect this data from the entire population. Use of this complete sample improved the likelihood that the study results were generalizable across municipal characteristics such as size, annual household income, and so on. Specificity of the variables may also affect external validity if any of

these variables limit the ability for future researchers to identify the setting and procedures to which they can be generalized. Each variable was carefully identified and defined to ensure that its application and relevance could be operationalized.

The greatest threat to validity is construct validity (Cook & Campbell, 1979). Construct validity of cause and effect addresses the most fundamental validity concern. While other factors unrelated to transportation infrastructure projects may have contributed to increases or decreases in crime over time, evidence of construct validity did exist. As anticipated in the research methodology, the primary independent variable, project density, and the dependent variables, crime 1 and crime 2, operated logically in measuring the hypothetical construct in the statewide analysis. In addition, the cross-sectional design inherent in this post-only correlational model provides for higher construct validity than longitudinal designs (Judd & Kenny, 1981, p. 182). To further address this concern regarding construct validity, I incorporated a case study as of this research.

The case study focuses on a single borough community. Gathering both quantitative and qualitative data specific to this community employed a combination of secondary data and one-on-one interviews. For Part A of the case study, I obtained crime data from the Penbrook Borough Police Department. This data provided a breakdown of the types of criminal activity that reported during the study period, as well as the number of incidents and complaints reported within each police region. For Part B, I conducted a series of one-on-one interviews to obtain qualitative data for analysis.

Qualitative research, like that in qualitative interview portion of the study, presents different validity or trustworthiness concerns than quantitative research.

Trustworthiness in qualitative research relies on credibility (researcher ability to fully explore the details), transferability (researcher ability to capture the details for others to understand), dependability (strength & consistency of the data), and confirmability (objectivity in collection and evaluation) (Gay, Mills, & Airasian, 2009, p. 376).

Reliability and validity concerns were also addressed during the interviews in qualitative portion of the case study. The interview guidelines standardized the questions and the interview process, strengthening reliability or dependability of the data. To strengthen validity and confirmability, I emphasized interpretive and theoretical validity (Gay, Mills, & Airasian, 2009). The interviews were designed and conducted to ensure that I carefully interpreted, understood, and recorded the respondents' perceptions based on their oral responses as well as their behaviors. I exercised caution to ensure that experimenter effects and reactive arrangements had minimal influence on the responses during the interviews. Both are common in case study research where the researcher is physically involved in the data collection and conscious or unconscious actions by the researcher can affect participants' responses. I took great care to ensure researcher – participant relationships were comfortable and non-threatening.

Transferability of the findings in Parts A & B of the case study is dependent on the findings in statewide quantitative analysis. If no difference exists between boroughs with high project densities and those with low or no project densities, then transferability would be considered minimal. However, if a difference does exist showing a crime reduction effect due to transportation intervention, then experiences relayed in the case study may transfer to other transportation infrastructure projects deemed substantive by the criteria noted earlier in in Table 3-2.

Strengths, Weaknesses, and Ethical Considerations

As noted in the aforementioned discussion on reliability and validity, this study has three major components, the quantitative look at Pennsylvania boroughs statewide, the secondary quantitative criminal report data in Part A of the case study, and the interview data collected in Part B of the case study. The strength of the methodological approach lies primarily in the ability to collect quantitative data from the entire population in the statewide analysis, providing a complete sample for analysis. A complete sample, as opposed to a representative sample, improves the likelihood that the study's results can be generalized to the target population. The use of secondary data from credible sources further strengthens this research. This data, which had already been collected and sanitized, provided quality information and minimized the risk of infringement on human rights. While the risks of using sanitary data relate to timeliness, form, and accessibility, the actual data utilized presented none of these issues.

Parts A and B of the case study pose a weakness in that the data applies to a single project in a single borough. Since the findings for this one example are not generalizable to other municipalities or the larger population, this poses a threat to reliability. These findings are intended to supplement the findings of the statewide analysis by providing additional insight to guide understanding.

I identified a final weakness in the interview process in Part B of the case study. While this approach offers an in-depth understanding of the complex issues of crime and transportation infrastructure in communities, the detailed contextual analysis of one case in particular cannot be generalized to a larger population. To account for this, I used the sequential explanatory mixed methods model such that the results of the localized

qualitative research can supplement and strengthen the previous statewide quantitative research. It is possible, however, that the qualitative component of the study might provide some insight into causal mechanisms which not likely with the quantitative component. This insight may provide the potential for theoretical generalizability.

This study included a variety of ethical considerations. Most notably, the research methodology exposed interview participants to moderate risk during the qualitative data collection phase. Based on the design of the data collection, the participants were not able to remain anonymous during the interview. Regardless of efforts to ensure confidentiality the limited number of participants and their roles in the community could enable individuals with access to the data to trace comments back to the individual participants who provided them. Appendix B provides a list of the measures I employed to address this risk. Appendix C is a copy of the Informed Consent Form that was distributed to and signed by all participants during the interviews as part of the case study.

Data Analysis Strategies

While the data analysis is set forth in detail in Chapter 4, this section provides an overview of the approach within the context of the research methods selected. For the quantitative phase of the study, I used descriptive and inferential statistics. Descriptive data identifies patterns and summarizes the data. Using descriptive statistics in the statewide quantitative analysis segment of this study evinces the presence of crime within the sample population. The inferential data generalizes from these patterns to draw conclusions.

I used multivariate multiple regression modeling to assess relationships among the independent, dependent, and control variables. This approach allowed me to analyze the relationship between the dependent variables and the independent variables irrespective of each other, thereby statistically controlling for demographic type variables that might introduce spurious effects.

Observations collected through the interviews in Part B of the case study were coded and thematically analyzed to determine the level of influence, if any, that transportation infrastructure project had on crime, a feeling of security, and/or guardianship. Triangulation of the data from four separate interview panels accounted for multiple perspectives and reduced the risk of bias or limitations. I then compared these results to the quantitative effects to formulate an integrated set of findings. I address these qualitative and empirical measures further in Chapter 4.

Chapter Summary

This chapter discussed the details for the methods used to address the research questions and study objectives introduced in Chapters 1 and 2. It also presented the methods used to conduct the research. This summary included a presentation of the research methodology; units of analysis; sampling frames, designs, and size; variables and their definitions (independent, dependent, and control variables); data collection; and instrument used for data collection. Wrapping up the methods discussion, the chapter provided an overview of the validity and reliability; strengths, weaknesses, and ethical considerations; and the approach to data analysis. This discussion sets the stage for a thorough presentation of the data analysis in Chapter 4.

CHAPTER IV

RESULTS

This chapter presents my analysis and results. My objective for this study was to examine the effects of transportation infrastructure on criminal behavior and determine if transportation infrastructure can serve as a viable social intervention to reduce criminal activity at the community level. I conducted this study in three parts. First, I ran a statewide quantitative analysis of the relationship between crime and transportation infrastructure among all Pennsylvania boroughs. I then conducted a two-part case study to examine the relationship between crime and transportation infrastructure in one specific borough using both quantitative and qualitative analysis. I used a mixed methods approach, causal-comparative (ex post facto) design to explore the following set of research questions:

1. Does transportation infrastructure have an effect on criminal behavior in communities?
2. If so, does this effect differ between serious crimes (Part I) and non-serious crimes and misdemeanors (Part II)?
3. Can transportation infrastructure serve as a viable social intervention that deters criminal behavior within communities while addressing transportation needs?
4. Can criminal opportunities or "hot spots" be limited or removed through improved designs for transportation infrastructure?

5. Do transportation infrastructure improvements improve a community's sense of security or guardianship, which can have an indirect relationship on crime?

This chapter divides into two segments, a statewide quantitative analysis and a case study analysis. The first segment provides a discussion of the quantitative analysis for the statewide sample. This analysis includes five sections: (a) descriptive analysis of the study sample; (b) explanation of the dependent, independent, and explanatory variables; (c) analytical model building; (d) the results of the inferential analysis used to test the hypotheses; and (e) the statewide quantitative analysis findings. The second segment in this chapter provides a discussion on the results of the case study, which I present in two parts. Part A of the case study includes specific quantitative analysis for the Borough of Penbrook and Part B reports the qualitative findings from the interviews I conducted with police, public works employees, and business owners in the community. Each segment concludes with findings relative to the specified analysis. The chapter concludes with an overall summary. I discuss the findings and offer suggestions for future research in the next chapter.

Statewide Quantitative Analysis

Descriptive Analysis

This section provides a summary of the sample used for the statewide data analysis. This includes the sample demographics and the transportation infrastructure project data, which address the number of transportation projects completed in each borough over a six-year period. This section also highlights six years of crime data

associated with each borough, which encompasses the six year transportation project period.

Demographic data. The sample studied in the statewide quantitative analysis included 956 boroughs and secondary data obtained from three separate sources. For each borough, I obtained secondary demographic data from the Center for Rural Pennsylvania based on the 2010 census. The values for each measure in Table 8 represent 2008-2012 (projected) figures.

Table 8

Demographic Data based on the 2008-12 Census

Borough Demographic Data 2008-2012 (projected)					
Description	**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
County Name	956	--	--	--	--
Borough Name	956	--	--	--	--
Borough Population	956	2,606	3,722	10	42,034
Population Density	956	2,448	2,093	9.4	15,637
Youth Population	953	547	753.17	0	8413.23
Median Age	943	41	6.5	12.6	73
Persons with no High School Diploma	950	11.9%	6.2%	0	47.7%
Median Household Income	943	$46,948	$15,948	$18,779	$183,750
Median Per Capita Income	943	$24,212	$8,435	$5,494	$113,489
Poverty Rate	953	13%	8.3%	0	69.6%
Unemployment Rate	953	8.3%	4.2%	0	42.8%

Transportation infrastructure project data. In order to compare criminal behavior in boroughs that completed transportation infrastructure projects with those that did not, I needed to determine which boroughs completed eligible projects over the designated six-year study period. I obtained secondary data on transportation project files from the Pennsylvania Department of Transportation that identified the major transportation infrastructure projects completed within the boroughs during the designated six-year window from 2005 through 2010.

The transportation infrastructure project data showed the number of active transportation projects by year as summarized in Table 9 below. Based on this information, of the 956 boroughs in Pennsylvania, 101 had active transportation infrastructure projects in 2005 and as many as 208 boroughs had active infrastructure projects in 2007. Of these, the maximum number of projects any one borough had in a given year was 7 projects in 2008. Aside from those that had no projects at all, the minimum number of projects in any given borough each year was 1.

Table 9

Active Transportation Projects by Year

Active Transportation Projects by Year					
Year	Obs	Mean	Std. Dev.	Min	Max
2005	101	1.29	.497	1	3
2006	188	1.44	.788	1	6
2007	208	1.35	.678	1	5
2008	183	1.34	.774	1	7
2009	204	1.49	.907	1	6
2010	145	1.30	.581	1	4

Crime data. To compare variations in criminal behavior across these boroughs, I obtained secondary crime data from the Uniform Crime Reporting System (UCRS) database. The UCRS reports crime based on severity levels, Part I and Part II, as noted in Table 10. For purposes of this study, I modified the datasets to exclude crime types that are not typically associated with street crimes, and would therefore not likely be affected by transportation infrastructure changes. The omitted crime types included Murder, Manslaughter, Forgery, Fraud, Embezzlement, Gambling, and Family Offenses. Since I excluded certain types of crime for this study, I used the absolute values of crime for this variable instead of an overall crime rate. To account for this I included population density and other measures as control variables. The modified datasets used in this study for Crime, Part I and Crime, Part II include the crimes listed in Table 11.

Table 10

UCRS Crime Severity Levels

UCRS Crime Severity Levels	
Crime, Part I	**Crime, Part II**
- Murder and non-negligent manslaughter - Manslaughter by negligence - Forcible rape - Robbery - Aggravated assault - Burglary (breaking and entering) - Larceny-theft (except motor vehicle theft) - Motor vehicle theft - Arson	- Other assault (simple) - Forgery and counterfeiting - Fraud - Embezzlement - Stolen property (buying, receiving, possessing) - Vandalism - Weapons: carrying, possessing, etc. - Prostitution and commercialized vice - Sex offenses (except forcible rape, prostitution, and commercialized vice) - Drug abuse violations - Gambling - Offenses against the family and children - Driving under the influence - Liquor laws - Drunkenness - Disorderly conduct - Vagrancy - All other Offenses

Table 11

Crime Types Used for Study

Modified Crime Types for Study by Severity Level	
Crime, Part I , Modified	**Crime, Part II, Modified**
- Forcible rape - Robbery - Aggravated assault - Burglary (breaking and entering) - Larceny-theft (except motor vehicle theft) - Motor vehicle theft - Arson	- Other assault (simple) - Stolen property (buying, receiving, possessing) - Vandalism - Weapons: carrying, possessing, etc. - Prostitution and commercialized vice - Sex offenses (except forcible rape, prostitution, and commercialized vice) - Drug abuse violations - Driving under the influence - Liquor laws - Drunkenness - Disorderly conduct - Vagrancy - All other Offenses

Similar to the UCRS division of major and minor crime types, I then combined these modified sets of crime types into two separate groupings of crime for purposes of this research (i.e., Crime Part I and Crime Part II).

Variable Generation

This section provides an explanation of how I generated the variables used in my analysis. I first discuss the generation of the two dependent variables. Next, I discuss the generation of the primary independent predictor variable, and then conclude with a discussion on how I generated the independent explanatory variables.

Dependent variables. Given that this study was intended to measure changes in criminal behavior, I derived my dependent variables from measures of crime. Using the UCRS breakdown of crime by severity according to Parts I & II, I treated each severity level as a separate measure in order to explore potential changes in crime by severity. In each case, I first imputed missing values to increase the number of measurable observations and then I generated two dependent variables, one for each severity level.

Crime I. The variable, Crime 1, represents the median measure for all crime data reported as Part I severity level by each borough in Pennsylvania from 2005 through 2010. This range coincides with the reported transportation project years (2005-2010).

Imputation. The crime data obtained from the UCRS included all available data reported by municipal police departments for years 2005 through 2010. As I examined the data, there were a considerable amount of missing values, particularly in the early years of the statewide crime reporting system implementation. Table 12 shows a summary of the crime (Part I) data as initially tabulated. The missing values reflect the number of reported observations subtracted from the total number of boroughs (956) in the study sample.

Table 12

Summary of UCRS Crime I Data

Summary of UCRS Crime, Part I Data					
Year	Obs	Missing	Mean	Median	Max
2005	378	578	116	62.5	1,994
2006	396	560	119	65.5	2,191
2007	458	498	104	51	1,873
2008	507	449	101	49	1,628
2009	519	437	96	48	1,352
2010	531	425	90	44	1,444

Using regression analysis, I calculated the predicted values and imputed the missing values for each year. I used the following regression equation to predict missing values for crime 1 for years 2005 through 2010, each producing an R^2 ranging from .8929 to .9705.

regress crime1(year) on square_root_poverty log_ youth population median_crime1

Table 13 shows a summary of this crime data with imputed values for missing values where the values were predicted. Unfortunately, in 387 (40%) of the cases, no crime data was reported at all; therefore, missing values in those cases could not be predicted. I left the values missing in these cases, leaving 569 usable observations.

Table 13

Crime I Data with Imputed Values

Crime I Data with Imputed Values					
Year	Obs	Missing	Mean	Median	Max
2005	569	387	89	40	1,994
2006	569	387	94	41	2,191
2007	569	387	91	40	1,873
2008	569	387	101	49	1,628
2009	569	387	91	43	1,352
2010	569	387	86	40	1,444

While the predicted values from the regression analysis provided a reasonable approach for imputing data, this method also generated negative values for some of the cases. Table 14 shows the number of cases per year where negative numbers were generated. In these cases, since crime cannot reasonably exist as a negative number, I

replaced these predicted values with zero. Following imputation, I calculated an overall median measure of crime for Part I severity level of crime that operated over this 6-year period for each borough. This final median measure generated my first dependent variable, crime I.

Table 14

Cases Where Crime I Negative Values were Replaced

Crime I Negative Cases Replaced		
Year	Values Replaced	% of Total
2005	36	6.3%
2006	32	5.6%
2007	20	3.5%
2008	0	0%
2009	0	0%
2010	13	2.3%

Univariate analysis of crime I. Figure 6 shows a combination of a histogram, box plot, symmetry plot, and quantile normal plot of the crime I variable. These individual plots all illustrate the same basic result from a different perspective. Based on these results, it is evident that the crime I variable has an abnormal distribution with a severe positive skew. In addition, several outliers are clearly visible in the box, symmetry, and quantile normal plots. This abnormal distribution may cause concerns in the regression analysis and will be further evaluated as part of the model building later in this chapter.

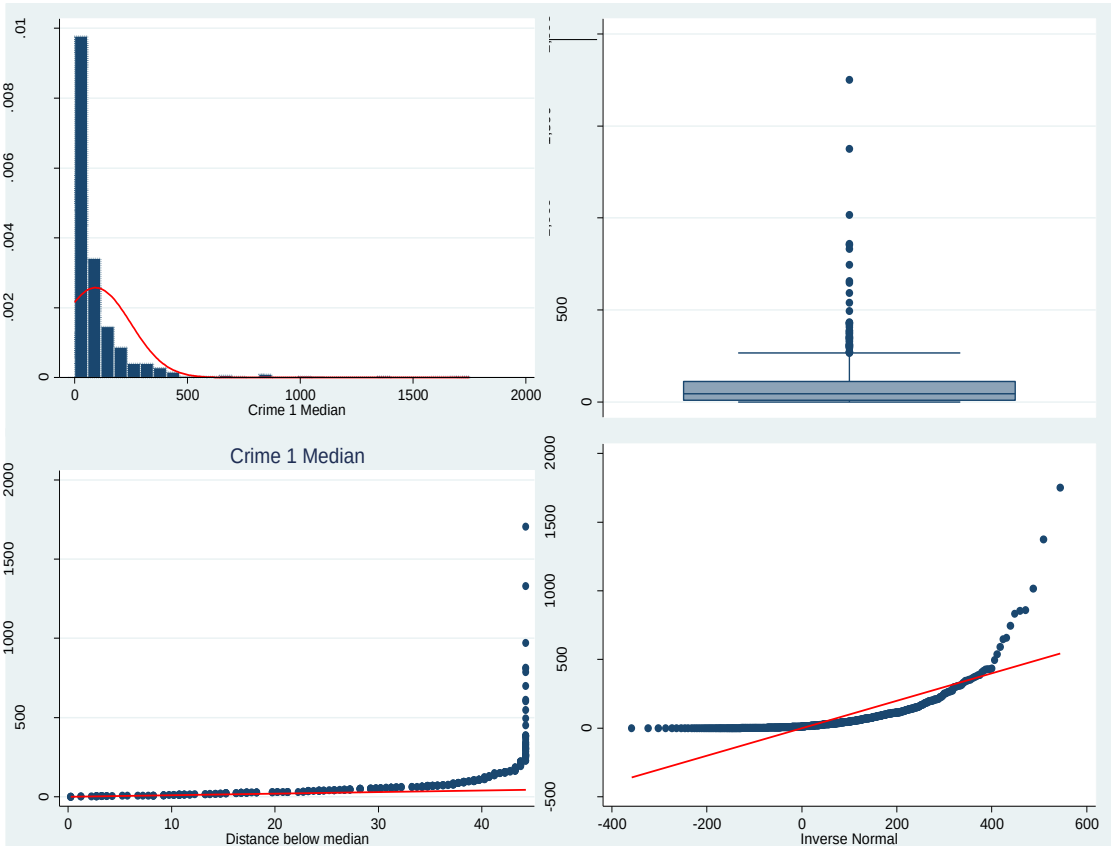

Figure 6. Combination of histogram, box, symmetry, and normal quantile plots for crime I.

Crime II. Similar to crime I, the variable, crime II, represents the median measure for all crime data reported as Part II severity level by each borough in Pennsylvania from 2005 through 2010. As with the Part I crime data, there were a considerable amount of missing values with the Part II crime data. Table 15 shows a

Table 15

Summary of UCRS Crime II Data.

Summary of UCRS Crime, Part II Data					
Year	Obs	Missing	Mean	Median	Max
2005	378	578	283	155	4,674
2006	396	560	296	153.5	5,565
2007	458	498	269	139	5,681
2008	507	449	250	124	5,653
2009	521	435	236	118	5,514
2010	531	425	228	104	5,034

summary of the crime (Part II) data as initially tabulated. The missing values reflect the number of reported observations subtracted from the total number of boroughs (956) in the study sample.

Using regression analysis, I calculated the predicted values and imputed the missing values for each year. I used the following regression equation to predict missing values for crime 2 each year (2005-2010), each producing an R^2 ranging from .9064 to .9680.

regress crime_2(year) on square_root_poverty log_youth_population median_crime2

Table 16 shows a summary of this crime data for Part II severity level with imputed values for missing values where the values could be predicted. Similar to Crime I, in 387 (40%) of the cases, no crime data was reported at all; therefore, missing values in those cases could not be predicted.

Table 16

Crime II Data with Imputed Values.

Crime II Data with Imputed Values					
Year	Obs	Missing	Mean	Median	Max
2005	569	387	212	97	4,674
2006	569	387	233	102	5,565
2007	569	387	232	99	5,681
2008	569	387	230	107	5,653
2009	569	387	223	108	5,514
2010	569	387	217	93	5,034

As with Crime I, predicting the missing values generated negative values for some of the cases. Table 17 shows the number of cases per year where negative numbers were generated. In these cases, since crime cannot be a negative number, I replaced these predicted values with 0. I then calculated an overall median measure of crime for Crime, Part II for this 6-year period for each borough. This final median measure yielded my second dependent variable, Crime II.

Table 17

Cases Where Crime II Negative Values were Replaced.

Crime II Negative Cases Replaced		
Year	Values Replaced	% of Total
2005	70	12.3%
2006	44	7.7%
2007	26	4.6%
2008	11	1.9%
2009	0	0%
2010	0	0%

Univariate analysis of Crime II. Figure 7 shows combination of a histogram, box plot, symmetry plot, and quantile normal plot of the crime II variable. In all four graphs

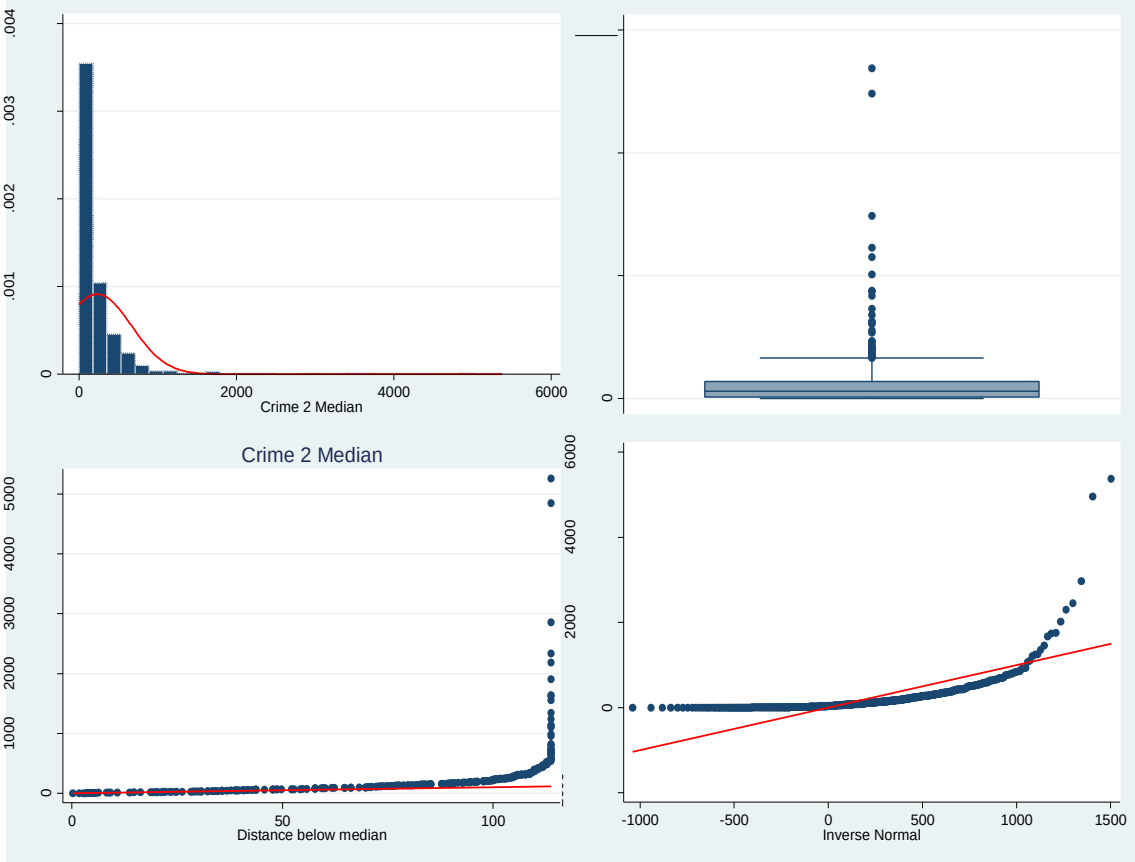

Figure 7. Combination of histogram, box, symmetry, and normal quantile plots for crime II.

the distribution is similar to the distribution of crime I. Based on these results, it is evident that the crime II variable also has an abnormal distribution with a severe positive skew and strong outliers. As observed with crime I, this abnormal distribution

may cause concerns in the regression analysis and will be further evaluated as part of the model building.

Independent variables. This study involves seven independent variables, which I introduce and discuss in this section. Among these independent variables, I have identified one primary explanatory or predictor variable that I used to predict change in each of the dependent variables. The remaining six variables serve as control variables. Because these variables are not the focus of this research, but may influence the dependent or explanatory variables in the analysis, I controlled for them in the regression model.

Recognizing that severely skewed and abnormally distributed independent variables may cause problems in my regressions analysis, I explored possible transformations using the Ladder of Powers (Tukey, 1977),and evaluated alternative transformations where applicable. These alternative transformations may or may not be used in the final regression model pending the results of regression diagnostics applied to critique model assumptions.

Project density. This variable serves as my explanatory independent variable because it represents the single element I am evaluating for its influence on my dependent variables. Project density was developed as a measure of the variance in transportation project activity across all of the boroughs in the sample population.

As noted earlier in this chapter, the number of active transportation projects varies from borough to borough and from year to year. In the majority of boroughs, no active transportation infrastructure projects occurred within the six-year study period at all. In other cases, a single borough may have had several transportation projects occurring

either simultaneously or back to back. To account for these variations in transportation infrastructure project activity among the boroughs, I generated an independent variable labeled "Project Density." Project Density measures total projects, project frequency, and project concentration. This new variable enabled me to use a continuous variable to differentiate among Pennsylvania boroughs that had no transportation infrastructure project activity, those that had some activity, and those that had consistent activity throughout the study period from 2005-2010. I describe each of the three elements and how they function to arrive at this measure.

Total projects. Total projects (tot_prjcts) represents the total number of active projects a borough had over the six-year period. As seen in Figure 4-3, the total number of active projects within any of the boroughs in Pennsylvania over this six-year timeframe ranges from 0 to 21.

Figure 8 shows a stem-and-leaf plot for the total number of transportation

Stem-and-leaf plot for tot_prjcts (Total Active Projects)

0* | 00000000000000000000000000000000000000000000000000000000000000000000 … (551)
0* | 11111111111111111111111111111111111111111111111111111111111111111111 … (90)
0* | 22222222222222222222222222222222222222222222222222222222222222222222 … (110)
0* | 33333333333333333333333333333333333333333333333333333333333333333333 (57)
0* | 44444444444444444444444444444444444444444444444444444444444444444444 (52)
0* | 55555555555555555555555555555555 (34)
0* | 66666666666 (11)
0* | 777777777777777 (15)
0* | 8888888888 (10)
0* | 9999999999 (10)
1* | 000 (3)
1* | 11 (2)
1* | 2222 (4)
1* | 3(1)
1* |
1* |
1* | 666 (3)
1* | 7 (1)
1* |
1* | 9 (1)
2* |
2* | 1 (1)

Figure 8. Stem-and-leaf plot for the number of transportation infrastructure projects.

infrastructure projects completed during the study period. This graphic clearly illustrates the positively skewed distribution of the data while showing the values for each of the observations. In this case, 551 boroughs had no projects from 2005 through 2010; 90 boroughs had just 1 project; 110 boroughs had 2 projects during the study period; and the remaining 200 boroughs had 3 or more projects. Only 16 boroughs had more than 10 projects with 3 boroughs having16 projects; 1 having 17 projects; and 1 having 21 projects during this study period.

Project frequency. Project Frequency (freq) represents the total number of actual years during which a borough has active projects. Although the study period covers a six-year window, boroughs may or may not have active projects for this entire period. Figure 9 shows a stem-and-leaf plot for the number of active project years. Aside from the 551 boroughs that had no projects, the majority of boroughs (148) had projects during two of the six years. Only 16 boroughs had projects during the entire six-year window. Among the boroughs that completed projects, 310 (76%) had active projects for up to one half of the study period (1-3 years) while 95 (24%) had active project for over half of the study period (4-6 years).

Stem-and-leaf plot for freq (Number of Years of Active Projects)

0* | 00000000000000000000000000000000000000000000000000000000000000000000000000000 … (551)
0* | 11111111111111111111111111111111111111111111111111111111111111111111111111111 … (95)
0* | 22222222222222222222222222222222222222222222222222222222222222222222222222222 … (148)
0* | 33333333333333333333333333333333333333333333333333333333333333333333333333333 (67)
0* | 44444444444444444444444444444444444444444444444444444444444444444444444444444 (54)
0* | 5555555555555555555555555 (25)
0* | 6666666666666666 (16)

Figure 9. Stem-and-leaf plot for the number of active project years.

Project Concentration. Project Concentration (prj_concen) represents the number of active project years that are consecutively linked. This measure takes into consideration the effect that muli-year projects may have on communities. Projects that last longer than one year or that occur back to back may provide more substantial enhancements and/or may create greater disruption in communities than single-year projects. Figure 10 shows a stem and leaf plot for consecutive years. The results are similar to the active project years with some slight variation in years 1 through 4. Considering on the number of consecutive project years, 291 (72%) of the boroughs implemented transportation infrastructure projects for 2 or more consecutive years. Sixteen of those boroughs had projects during the entire study period.

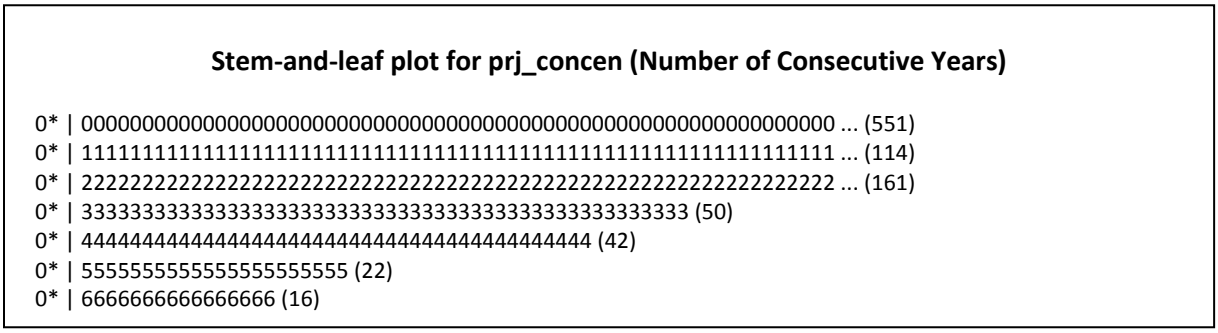

Figure 10. Stem-and-leaf plot for the number of consecutive years.

Project density calculation. Project density measures the level of transportation infrastructure project activity over the six year period. It is calculated by combining the three measures discussed above. First, project concentration is divided by the project frequency to provide a measure of intensity, or the amount of the time during the study period is affected by the project activity. This figure is then multiplied the total number of projects to factor in the number of projects involved in this activity. The final calculation for project density is as follows:

Project Density = Total Projects x (Project Concentration / Project Frequency)

The correlation matrix in Table 18 shows that project density is highly correlated with each of its component measures, total projects being the strongest of all. While this correlation suggests that total projects is, on its own, a suitable measure, the composite measure theoretically provides a better measure of overall infrastructure project activity.

Table 18

Correlation Matrix of Project Density and its Component Measures.

	Total Projects	Project Frequency	Project Concentration	Project Density
Total Projects	1.0000			
Project Frequency	0.9104	1.0000		
Project Concentration	0.9065	0.9857	1.0000	
Project Density	0.9903	0.8920	0.9106	1.0000

The characteristics of this predictor variable, project density, are summarized in Table 19. This summary shows that no missing variables since all 956 boroughs are represented in the calculation. The majority of boroughs had a project density score of zero, which corresponds to the number of boroughs (551) that had no projects noted earlier in the stem and leaf plot (Figure 8). The maximum project density score was 21. The examples in Table 20 illustrate subset of example calculations for project density taken from the available data.

Table 19

Summary of Project Density.

Summary Statistics for Project Density					
Variable	**Obs**	**Mean**	**Median**	**Min**	**Max**
Projdens	956	1.389313	0	0	21

Table 20

Example Project Density Calculations.

Example Project Density Calculations				
Example Boroughs	**Total Projects**	**Project Frequency**	**Project Concentration**	**Project Density**
Apollo	3	2	2	3
Big Beaver	10	4	3	7.5
Blossberg	5	4	3	3.75
Cambridge Springs	3	2	1	1.5
Carnegie	4	3	3	4
Chalfont	4	3	1	2.67
Millvale	2	2	1	1
Monroeville	21	6	6	21
New Holland	2	2	2	2
Newtown	0	0	0	0
Ridgeway	16	6	6	16
Somerset	12	5	5	12
Troy	4	4	3	3
Tyrone	7	3	4	5.25
West Mifflin	9	6	6	9
White Haven	7	5	5	7
Wrightsville	4	2	2	4

Figure 11 shows a combined histogram with normal curve overlay and box plot for project density. The distribution for this variable shows a severe positive skewness with strong outliers. Using the Ladder of Powers (Tukey, 1977) to assess alternative transformations, project density remained granular and highly skewed, even when all of the zeros were removed. Based on this assessment I determined that project density is not subject to power transformation. While a regression analysis does not require that independent variables have normal distributions (Hamilton, 1992), I will nonetheless investigate any possible influence this variable may have on the analytical model's underlying assumptions later in this chapter.

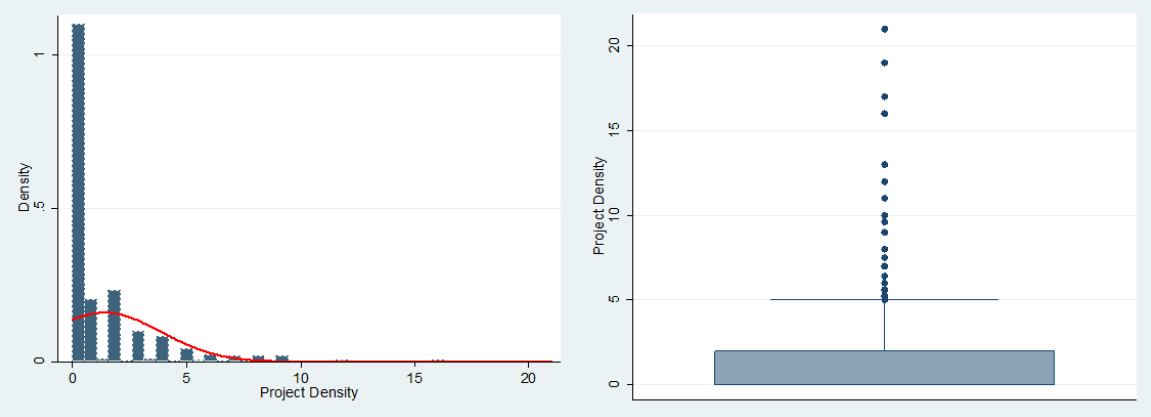

Figure 11. Combined histogram and box plot for project density.

Control variables. In addition to the above explanatory variable, this analysis relies on six additional control variables. These variables represent factors in my analysis that must be controlled or held constant to allow for a reasonably accurate assessment of the relationship between the explanatory variable (project density) and the dependent variables (crime I and crime II). The control variables presented here operate primarily as borough demographic characteristics such as population density, poverty level, and per capita income, each of which are likely to influence crime at the borough level and therefore distort the results. Including these variables in the model and holding them constant allows me to assess the effect that transportation infrastructure has on crime regardless of the size, population, income, etc. within each borough and maximizes the explained variability of the dependent variable. For example, population density reflects the varying sizes of communities and borough size directly correlates with the amount of crime. Since I need to be able to observe effects irrespective of population, I have selected population density as a control variable. Below, I introduce and discuss each of the other control variables used in this study.

Per capita income. Per Capita Income (percap) represents the median per capita income rate for each borough during the census period from 2008 – 2012. The FBI lists

economic conditions, specifically noting median income, as a primary factor known to influence crime (U.S. Department of Justice, Federal Bureau of Investigation, 2010). In addition, a 2002 study by the World Bank, reports that income inequality and crime rates are positively correlated (Fajnzylber, Lederman, & Loayza, 2002). Per capita income, as a measure of income inequality, is therefore a determinant of crime. For example, wealthier communities have more resources to monitor and guard against criminal behavior. Figure 12 shows a combined histogram with a normal curve overlay and box plot for the per capita income variable pre and post transformation. The initial distributions show a positive skew with strong outliers that may require a power transformation for the inferential analysis to ensure valid hypothesis tests. Using the Ladder of Powers (Tukey, 1977) to assess alternative transformations I determined the

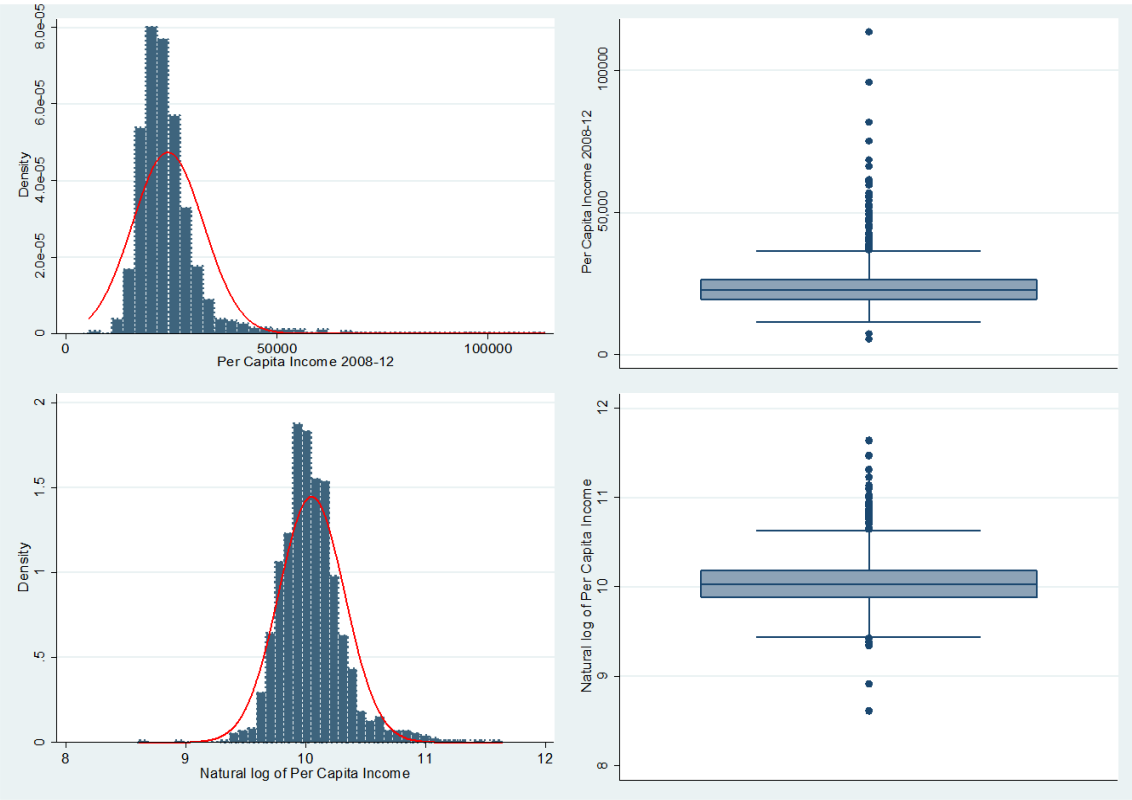

Figure 12. Combination of a histograms and box plots of per capita income before and after transformation.

natural log transformation provided a distributional shape that most closely resembled normal. The graphs using the natural log transformation show more normal distributions with fewer outliers.

Poverty. Poverty (pov) represents the median poverty rate for each borough during the census period 2008-2012. Crime and poverty have long been associated. As noted the "Concentric Zone Theory" (Park, Burgess, & McKenzie, 1925; Lilly, Cullen, & Ball, 2007) discussed in chapter three, Zone 2 is referred to as the "zone in transition," and depicts it as the least desirable area of a city because of its constant state of transition, social disorganization, poverty, and consistently higher rates of crime. Figure 13 shows histograms with normal curve overlays and box plots for the poverty variable pre and post transformation. The distributions prior to transformation show right-tailed skewness

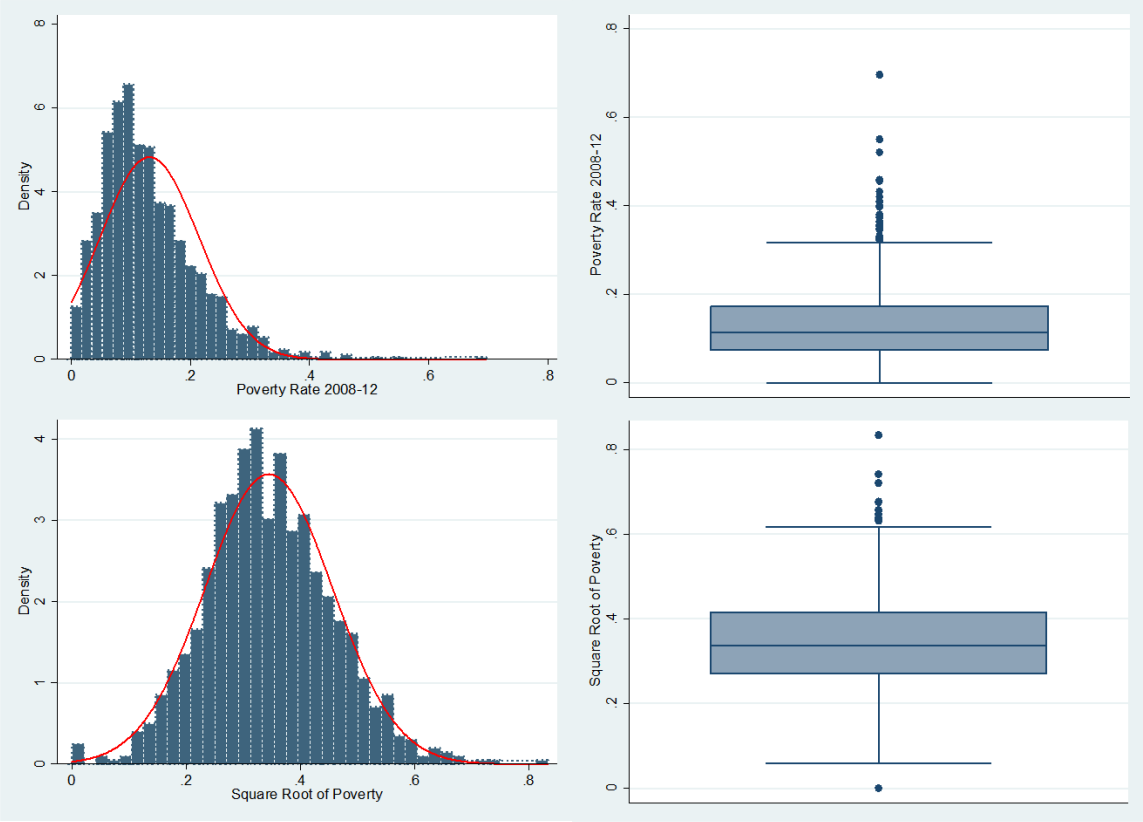

Figure 13. Combination of histograms and box plots of poverty rate before and after transformation.

with a few outliers. After assessing alternative transformations, I selected the square root transformation. These graphs show more normally shaped distributions for poverty.

Education. Education (edu) represents the percent of persons with no high school diploma during the census period 2008-2012. I am controlling for education based on its close association with employment and income, and therefore its anticipated effect on crime. Figure 14 shows combined histograms with normal curve overlays and box plots for this variable pre and post transformation. The distributions prior to transformation show an abnormal right-tailed skewness. After assessing alternative transformations, I selected the square root transformation. These graphs show more normally shaped distributions for education.

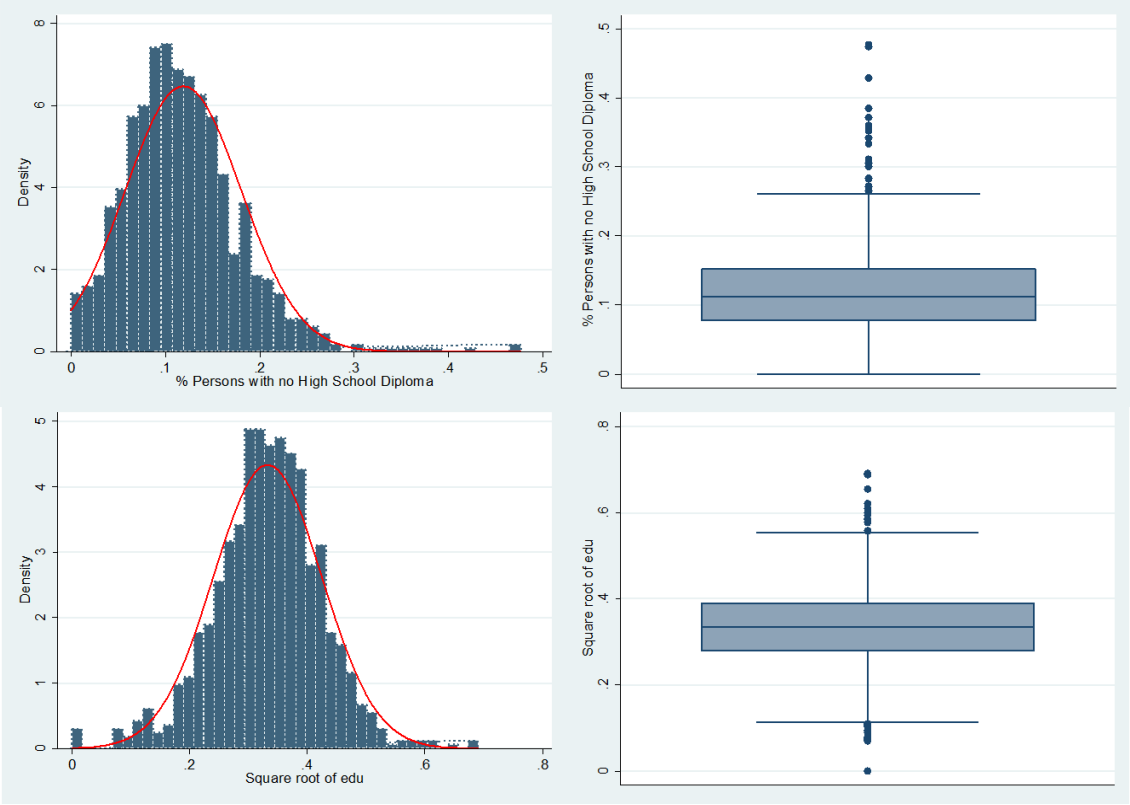

Figure 14. Combination of histograms and box plots of education before and after transformation.

Population density. Population density (popdens) represents the median population density for the census period 2008-2012. Population density is a direct reflection of the size of a community. This variance is logically an influential factor on crime rate, therefore I have decided to control for population in my analysis. Figure 15 shows combined histograms with normal curve overlays and box plots for popdens pre and post transformation. The distributions prior to transformation show a heavy right-tailed skewness with strong outliers. After assessing alternative transformations, the square root transformation provided for a distribution that most closely resembled normal. These graphs show more normally shaped distributions for this variable.

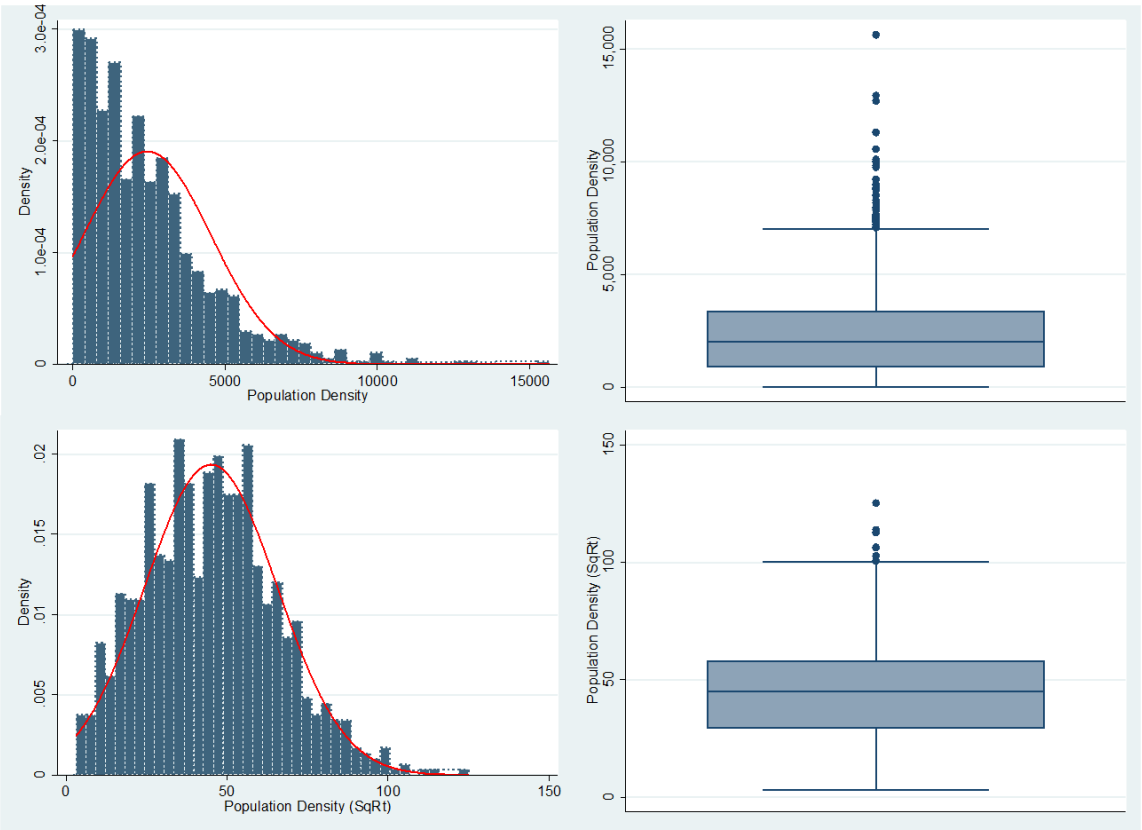

Figure 15. Combination of histograms and box plots of population density before and after transformation.

Age. Age (age) represents the median age for each borough population during the census period for this study. Among the factors known to affect the volume and type of

crime, the FBI lists variations in the composition of the population (U.S. Department of Justice, Federal Bureau of Investigation, 2010). Age is one primary measure of this variation. Older communities experience less crime than younger communities do. Figure 16 shows a histogram with a normal curve overlay and box plot for this variable. The current distributions appear somewhat normal with no outliers, therefore transformation did not seem necessary and I left the age data in their initial state.

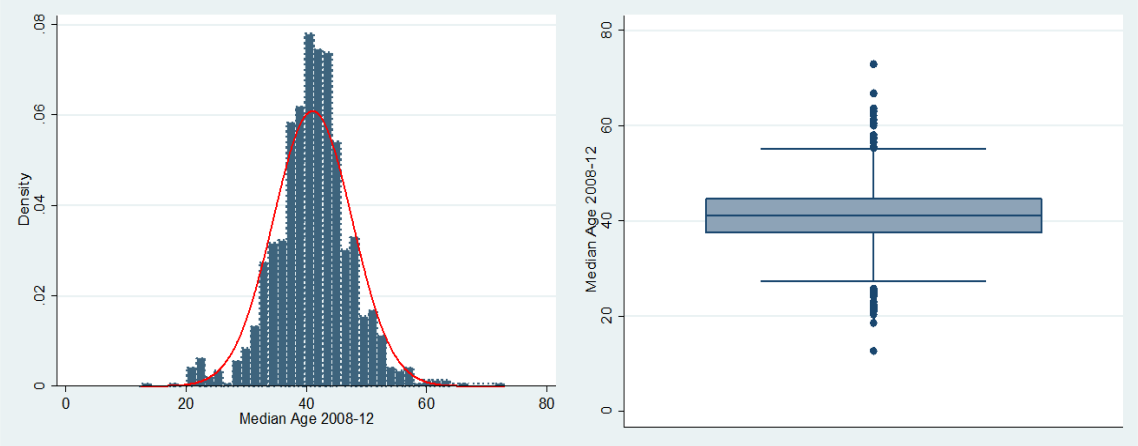

Figure 16. Combined histogram and box plot for age.

Youth population. Youth population (ypop) represents the number of individuals under the age of 18 during this census period. Similar to age, youth population is likely a strong influence on the amount of crime a community experiences. As with the other control variables, controlling for youth population will help in isolating the effects of project density on crime. Figure 17 shows histograms with normal curve overlays and box plots for this variable pre and post transformation. The distributions prior to transformation show heavy right-tailed skewness with very strong outliers. After assessing alternative transformations, I selected the natural log transformation. This distribution more closely resembles a normal shaped distribution.

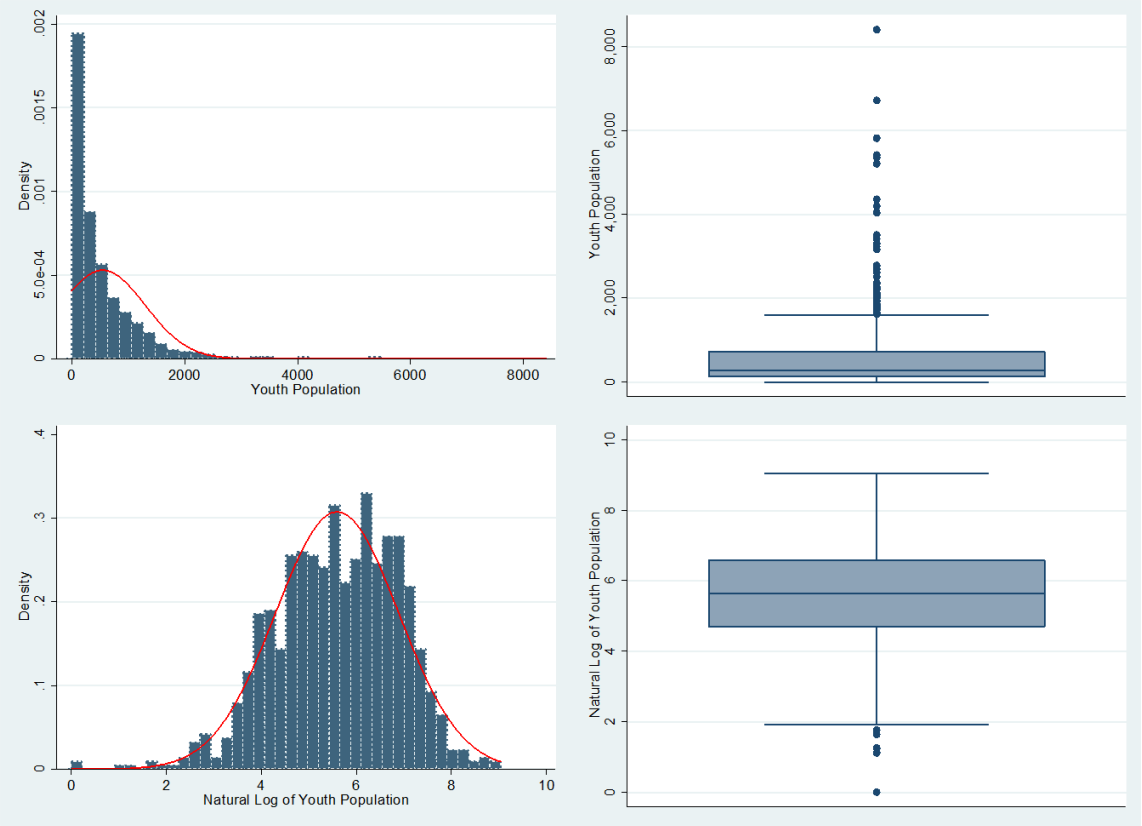

Figure 17. Combination of histograms and box plots of youth population before and after transformation.

Unemployment Rate. Unemployment rate (unempl) represents the percent of the population that was unemployed during this census period from 2008-2012. Similar to income, poverty, and crime, unemployment is also a likely influence on crime. Based on its variance across each of the boroughs, unemployment is included among my control variables. Figure 18 shows histograms with normal curve overlays and box plots for unemployment pre and post transformation. The distributions prior to transformation show a slight positive skew with a few outliers. The square root transformation most closely resembled a normal shape. The graph after this transformation shows a more normally shaped distribution.

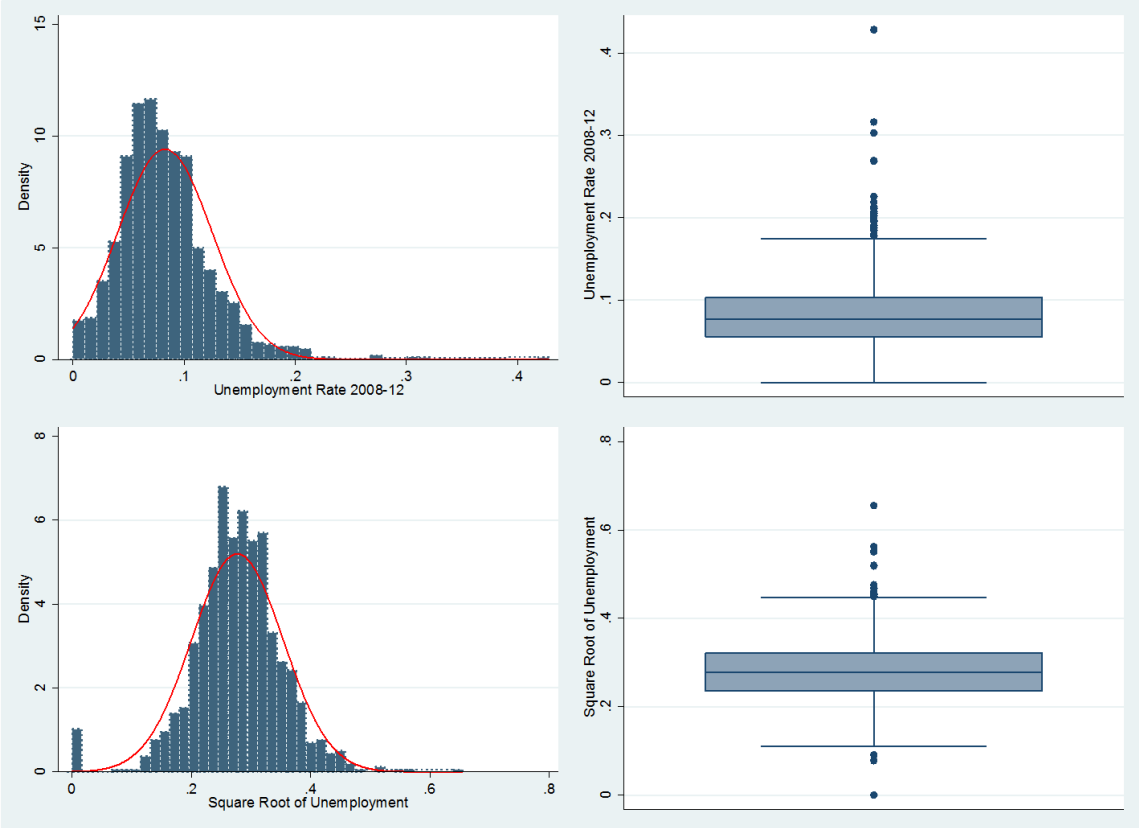

Figure 18. Combination of histograms and box plots of unemployment rate before and after transformation.

Summary of control variables. A summary of results from these analyses of the control variables is illustrated in Table 21. I listed the original variables along with their corresponding transformed variables. I will consider the possible transformations as part of the regression diagnostics used for developing the analytical model.

Table 21

Summary of Control Variables

Summary of Control Variables			
Original Variable	**Description**	**Possible Transformation**	**Transformed Variable**
percap	Per Capita Income	Natural Log	ln_percap
pov	Poverty Rate	Square Route	sqrt_pov
edu	% Persons with no high school diploma or GED	Square Route	Sqrt_edu
popdens	Population Density	Square Route	sqrt_popdens
age	Median Age	No Change	age
ypop	Youth Population	Natural Log	ln_pop
unempl	Unemployment Rate	Square Route	sqrt_unempl

Model Building

This study examines the influence of transportation infrastructure on criminal behavior. To analyze these effects, I generated two dependent variables, crime I and crime II, along with seven independent variables as discussed above. In this section, I explain how I used these variables to build the final regression model. First, I ran an ordinary least squares regression analysis for each dependent variable using the same independent variables, once with non-transformed variables and a second time with transformed variables. Using the regression output, I performed diagnostics to look for normal i.i.d. errors, influential cases, and multicollinearity. As needed, I ran alternative models such as robust regression. After investigating each dependent variable individually and running the regression diagnostics, I then ran a multivariate regression model to test the effect of project density, irrespective of the control variables, across both dependent variables simultaneously.

Crime I model. Using my first dependent variable and the seven independent variables generated in the previous section, I ran an initial OLS regression of crime I with non-transformed variables. I then produced a VIF (variance inflation factor) matrix to assess the level of multicollinearity that may exist in the regression analysis. Table 22 shows that, irrespective of the dependent variable, comparing the regression of every *x* on every *x*, the variables are independent and multicollinearity is weak. However, the RVF plot in Figure 19 shows a heteroscedastic pattern with abnormal i.i.d. (independent and identically distributed) errors, indicating dependency among the residuals.

Table 22

VIF Matrix of Crime I with Non-Transformed Variables.

Variable	VIF	1/VIF
percap	1.77	0. 563381
pov	1.69	0. 590315
edu	1.37	0. 727501
age	1.31	0. 763047
ypop	1.31	0. 765464
popdens	1.30	0. 770101
unempl	1.28	0. 781474
projdens	1.19	0. 837052
Mean VIF	1.40	

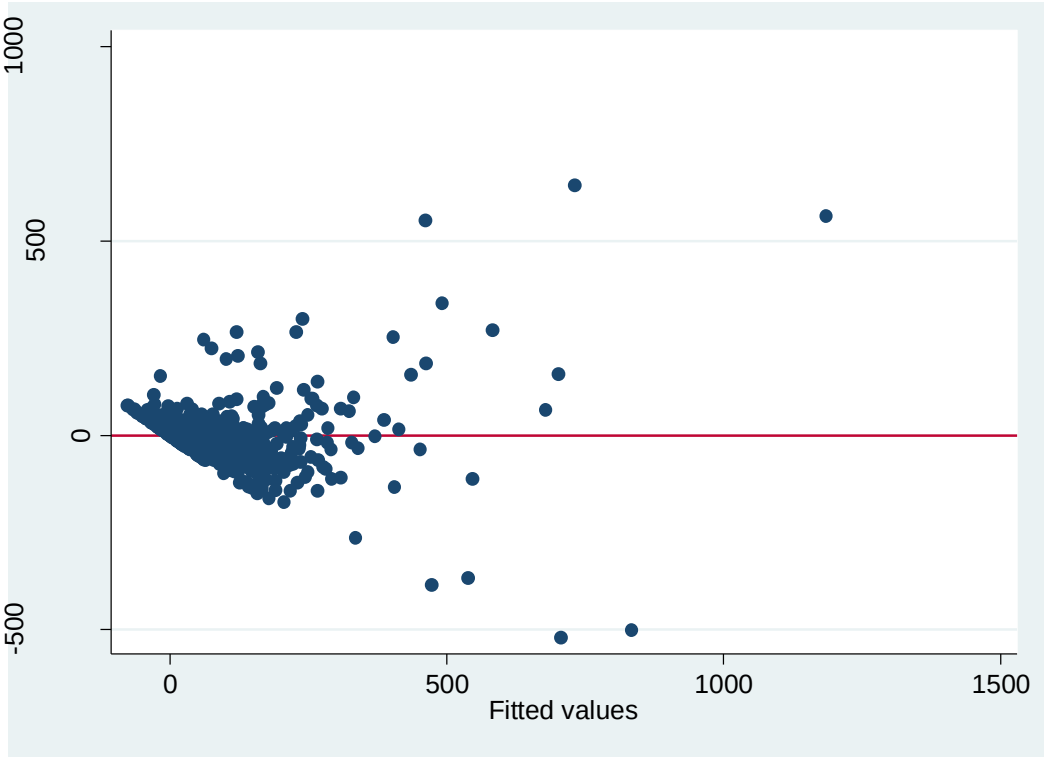

Figure 19. RVF plot of crime I.

Transformation of crime I. To adjust and generate a more sound model, I evaluated potential transformations for this dependent variable using the ladder of powers (Tukey, 1977). Since many of the observations for crime I had a value of zero, I added 1 to each data point in order to anchor the distribution at 1 versus 0, thereby providing for a more effective transformation. Figure 20 shows the distributional shapes associated with possible transformations. The natural log transformation appears to provide a distribution that more closely fits a normal distribution.

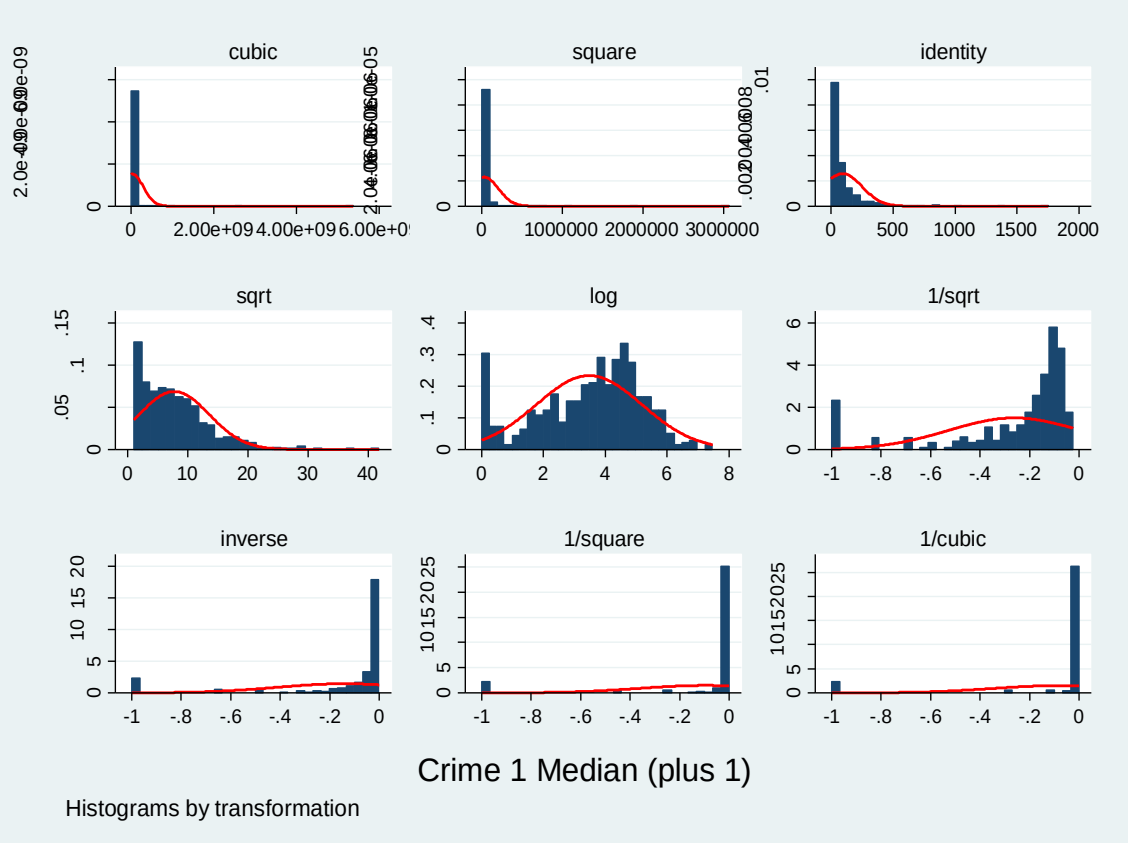

Figure 20. Power of Ladders alternatives for transformation of crime I.

Figure 21 shows a series of post-transformation graphs for crime I (log_c1med). The histogram with a normal distribution curve after transforming crime I to its natural log generates a much more normal shaped distribution. The box plot also shows the

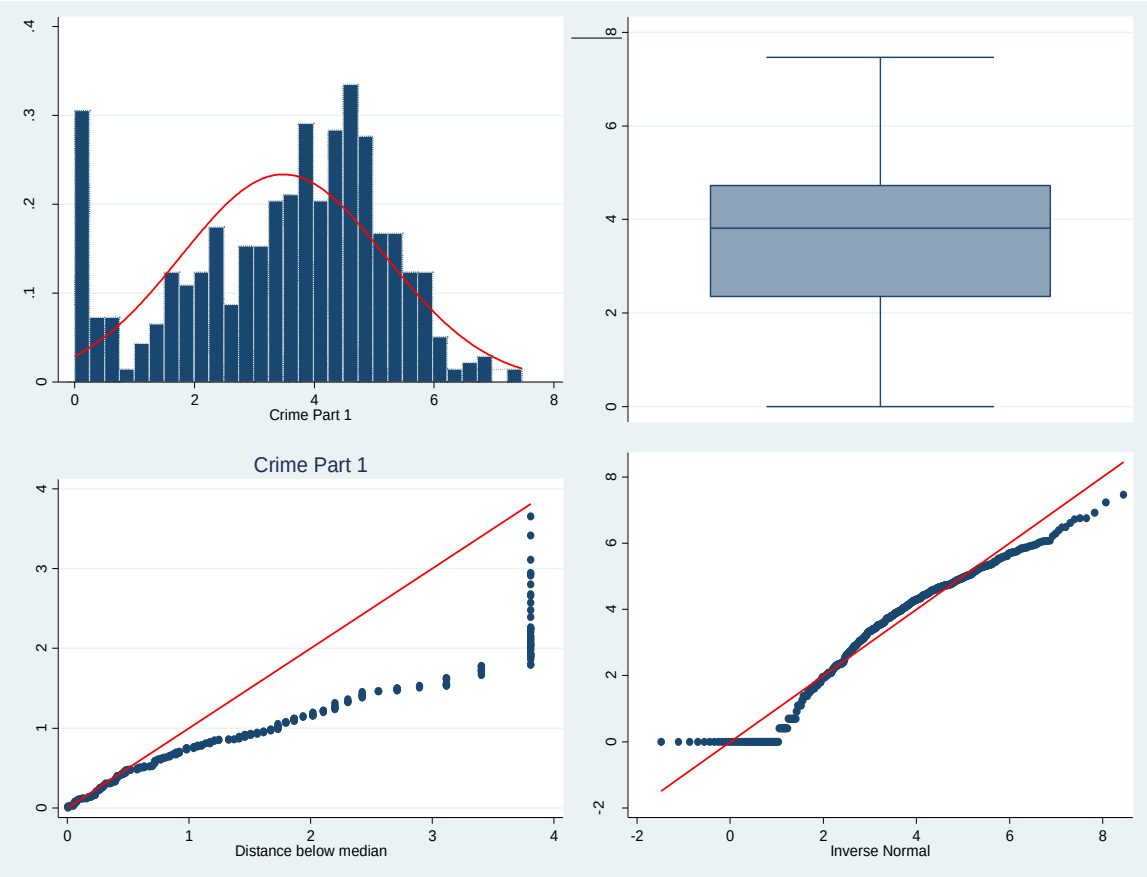

Figure 21. Combination of histogram, box, symmetry, and normal quantile plots after transformation of crime I.

distribution as relatively normal in shape after the natural log transformation. The symmetry plot, however, still shows that the distribution is not symmetrical and the normal probability plot further demonstrates that some abnormalities remain, but with less variance than prior to transformation. Nonetheless, this transformation may likely provide a solution for avoiding deviations associated with the regression error assumptions.

Based on the results of this transformation, I selected the natural log of crime I (ln_c1md) as the dependent variable for the next regression equation for crime I on the untransformed independent variables. Figures 22 shows combined RVF and

LVR2 plots that resulted. The RVF plot still shows a heteroscedastic pattern with non-normal i.i.d. errors, therefore I added transformations of the independent variables using the analyses presented previously.

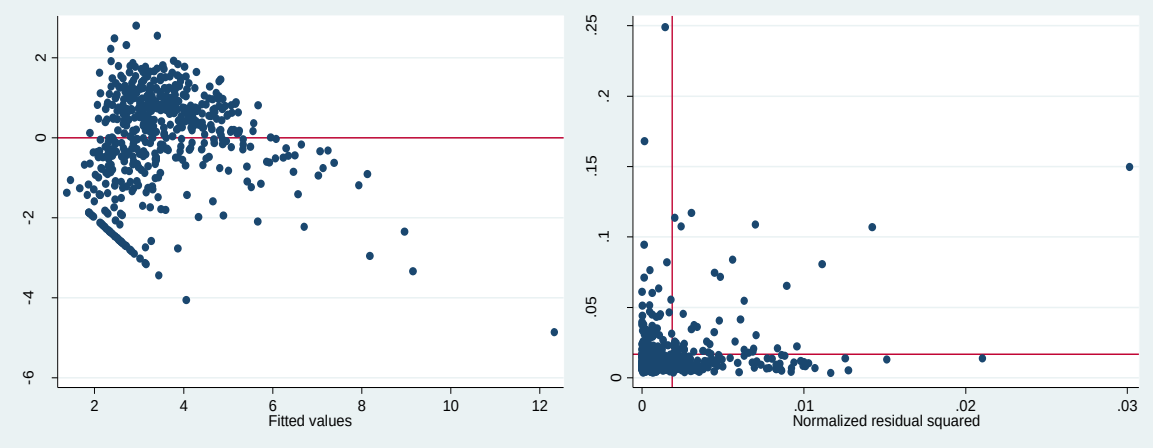

Figure 22. Combined RVF and LVR2 plots for crime I (log).

Testing for multicollinearity. I ran a third regression equation using the natural log transformation of crime I, this time including the transformed independent variables. The RVF plot in Figure 23 shows a marked improvement in the distribution of errors, although not an ideal "all clear" homoscedastic pattern.

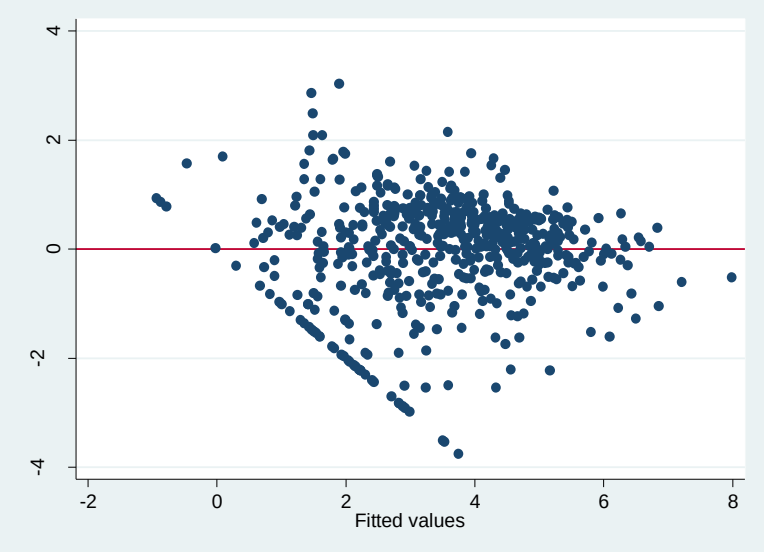

Figure 23. RVF plot for crime I with natural log transformation and transformed independent variables.

In addition, the VIF matrix in Table 23 shows that there are multicollinearity issues with per capita (ln_percap) and poverty (sqrt_pov), which are below 0.5. These results indicate these two variables relate to each other within the multivariate space.

Table 23

VIF Matrix for Crime I Median (log)

VIF Matrix for Crime I Median (log)		
Variable	**VIF**	**1/VIF**
ln_percap	2.91	0.343463
sqrt_pov	2.22	0.449615
ln_ypop	1.60	0.625428
sqrt_edu	1.57	0.635026
sqrt_popdens	1.51	0.663096
age	1.38	0.726207
sqrt_unempl	1.35	0.739980
projdens	1.22	0.820635
Mean VIF	1.72	

Based on the results of this analysis, only one of these variables should be in the final regression model. I then regressed project density (projdens) in similar regression equations, one excluding poverty rate (sqrt_pov) and the next excluding per capita income (ln_percap) to compare the results. While differences were minimal, I selected the model using poverty rate, which produced the highest adjusted R-squared (.6786 versus .6772). The VIF matrix in Table 24 shows no issues of multicollinearity exist among the remaining independent variables.

Table 24

VIF Matrix for Crime I (log) Excluding Per Capita Income

VIF Matrix for Crime I (log)		
Variable	**VIF**	**1/VIF**
sqrt_pov	1.60	0.626675
ln_ypop	1.53	0.652317
sqrt_popdens	1.51	0.663208
sqrt_edu	1.31	0.764934
sqrt_unempl	1.30	0.767875
Age	1.29	0.775800
Projdens	1.22	0.820646
Mean VIF	1.39	

Final regression model for crime I. My final regression model includes transformed dependent and independent variables, excludes per capita income, and includes all available observations (N = 540). Figure 24 shows combined RVF and LVR2 plots from this final regression model for crime I, which excludes per capita income. The distributions in the RVF plot show the residuals with a more homoscedastic distribution, although there are still deviations from the normal i.i.d error assumptions. While I had reasonably normal i.i.d. errors, a definite non-normal pattern existed calling these assumptions into question. I therefore ran the regression with robust standard errors. Again, I did not find any differences among the results and therefore chose to use the OLS regression with transformed variables for the final analysis.

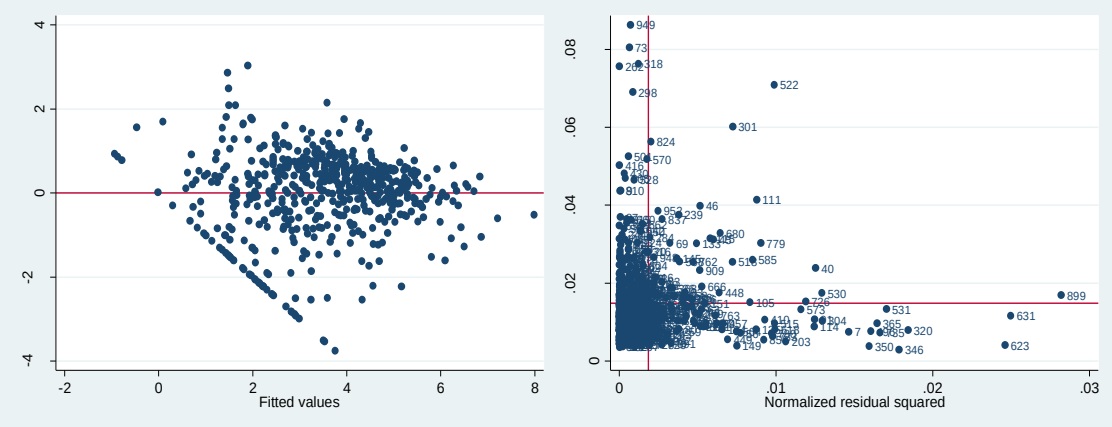

Figure 24. Combined RVF and LVR2 plots for crime I final regression model.

After reviewing diagnostic plots and comparing results with alternative regression models, I felt confident using an OLS (ordinary least squares) regression with transformed variables as shown in Table 25. The output shows a statistically significant F (p>.0000), indicating model significance. Based on the strength of the adjusted R^2, which takes into account the complexity of the model, nearly 68% of the variance of crime I is accounted for by the model.

Table 25

Regression of Crime I on Seven Independent Variables.

Source	SS	Df	MS			
Model	1074.39252	7	153.484646	Number of obs	=	540
Residual	499.220973	532	.938385288	F(7, 532)	=	163.56
				Prob > F	=	0.0000
				R-squared	=	0.6828
Total	1573.61349	539	2.91950556	Adj R-squared	=	0.6786
				Root MSE	=	.9687

log_c1med	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
projdens	.0485034	.0159472	3.04	0.002	.0171761	.0798306
ln_ypop	1.331842	.0563507	23.63	0.000	1.221144	1.442539
sqrt_popdens	.0154705	.002634	5.87	0.000	.0102962	.0206448
age	.008568	.0080419	1.07	0.287	-.0072297	.0243657
sqrt_edu	.3234568	.589159	0.55	0.583	-.8339066	1.48082
sqrt_pov	.90346	.5103691	1.77	0.077	-.099126	1.906046
sqrt_unempl	-1.051985	.761428	-1.38	0.168	-2.547759	.4437897
_cons	-6.284523	.5935521	-10.59	0.000	-7.450517	-5.11853

Crime II model. To develop a regression model for crime II, I started with an initial regression of crime II using my second dependent variable and the seven independent variables similar to crime I. Because the independent variables remained the same between the two models, the resulting VIF matrices for the crime II models were identical to those produced using crime I. However, the RVF plot in Figure 25 differs

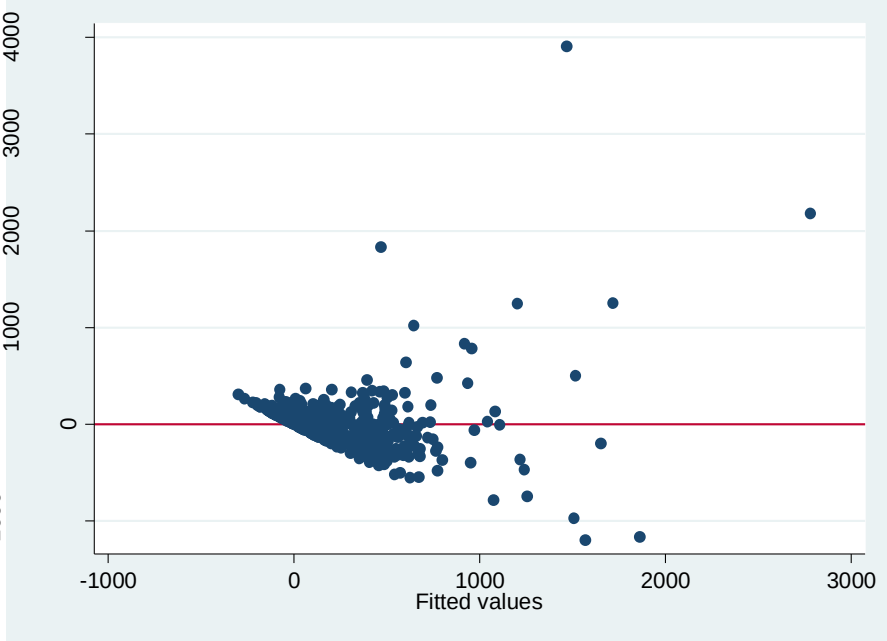

Figure 25. RVF plot crime II.

from crime I showing even greater distortion of the normal i.i.d. error assumptions, which suggests an alternative model may be preferred.

Transformation of crime II. As with crime I, I evaluated potential transformations for the crime II variable using the ladder of powers (Tukey, 1977). As with crime I, the distribution using the natural log transformation most closely resembled a normal distributional shape. Figure 26 shows a series of post-transformation graphs with results that closely resemble those for crime I.

Based on the results of this transformation, I selected the natural log of crime II (log_c2med) as the dependent variable in the second regression equation. Figures 27 shows combined RVF and LVR2 plots that resulted. Although somewhat improved, the RVF plot still shows a heteroscedastic pattern resulting in non-normal i.i.d. errors. To address these concerns, I included the transformed independent variables.

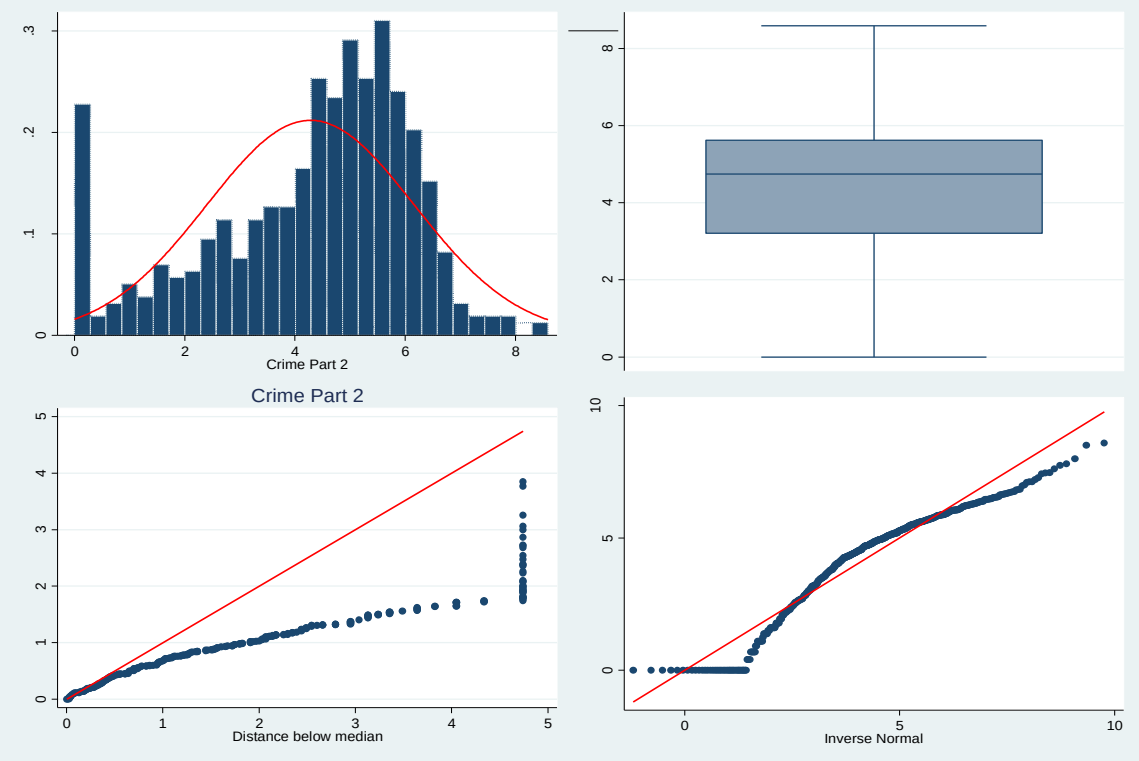

Figure 26. Combination of histogram, box, symmetry, and normal quantile plots after transformation of crime II.

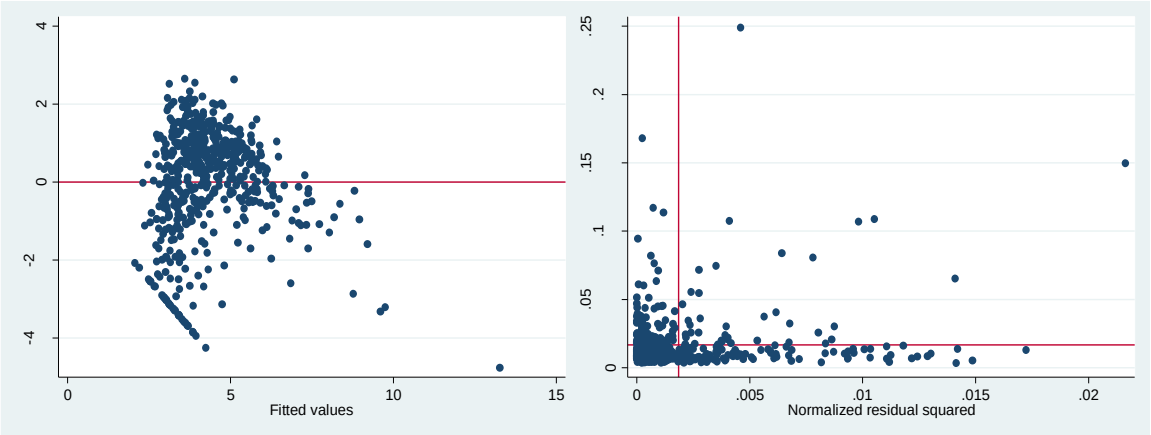

Figure 27. Combined RVF and LVR2 plots for crime II (log).

I ran a third regression equation using the natural log of crime II including the transformed independent variables. The RVF plot in Figure 28 shows an improvement in the distribution of errors, although not an ideal homoscedastic pattern. The plot still indicates some deviation from the normal i.i.d. error assumptions.

As with crime I, the same multicollinearity issues with per capita income (ln_percap) and poverty rate (sqrt_pov) existed. I again regressed projdens in similar regression equations using crime II (ln_cr2md) as the second dependent variable, one excluding poverty rate (sqrt_pov) and the next excluding per capita income (ln_percap). Given the strength of the adjusted R^2 in the model using poverty rate over per capita income (.6350 versus .6302), I chose to exclude per capita income in the final regression model.

Final regression model for crime II. The final regression model for crime II includes transformed dependent and independent variables, excludes per capita income, and includes all observations (*N=540*). Figure 28 shows the combined RVF and LVR2 plots from this final regression model for crime II that excludes per capita income. As

with crime I, the distributions in the RVF plot are better but there are still deviations from normal i.i.d error.

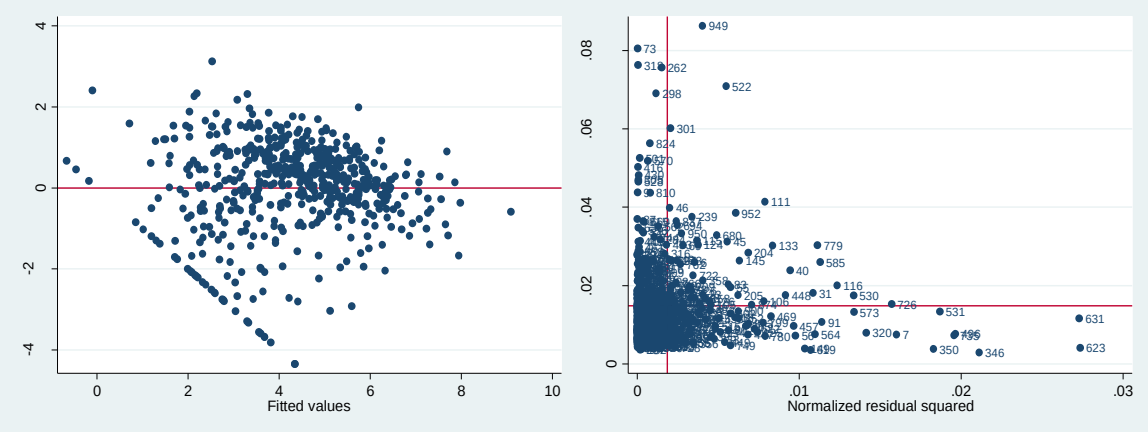

Figure 28. Combined RVF and LVR2 plots for crime II final regression model.

Similar to crime I, I performed a robust regression and a regression with robust standard errors. In both of these alternative models, I did not find results that significantly departed from the OLS regression and therefore had confidence using the OLS model for the final analysis.

As with crime I, I felt confident with the OLS (ordinary least squares) regression with transformed variables. The correlation matrix in Table 26 shows that both dependent variables correlate highly, further indicating that similar regression results were expected.

Table 26

Correlation Matrix for Dependent Variables Crime I and Crime II.

	ln_c1md	Ln_c2md
ln_c1md	1.0000	
Ln_c2md	0.9191	1.0000

Table 27 shows the output for the final crime II OLS regression with results. The F was statistically significant (*p>.0000*), indicating a statistically significant model. The

adjusted R^2 was very close to that for crime I, similarly showing nearly 68% of the variance of crime II accounted for using this model.

Table 27

Regression of Crime II on Seven Independent Variables.

Source	SS	Df	MS			
Model	1225.7357	7	175.105101	Number of obs	=	540
Residual	690.139471	532	1.29725465	F(7, 532)	=	134.98
				Prob > F	=	0.0000
				R-squared	=	0.6398
Total	1915.87518	539	3.5544994	Adj R-squared	=	0.6350
				Root MSE	=	1.139

log_c2med	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
projdens	.0414617	.0187503	2.21	0.027	.00462811.	.0782954
ln_ypop	.0176741	. 003097	5.71	0.000	0115904	.0237579
sqrt_popdens	1.398854	. 0662554	21.11	0.000	1.2687	1.529009
age	.0049581	. 0094554	0.52	0.600	-.0136164	.0235326
sqrt_edu	-.3227321	. 6927149	-0.47	0.641	-1.683524	1.03806
sqrt_pov	1.73844	. 6000762	2.90	0.004	.5596385	2.917258
sqrt_unempl	-.846793	. 8952635	-0.95	0.345	-2.605478	. 9118923
_cons	-5.99763	. 6978801	-8.59	0.000	-7.368569	-4.626691

Multivariate Multiple Regression Incorporating Crime I and Crime II

The multivariate multiple regression model differs from a simple multiple regression model in that it allowed me to test the overall model and the effect of the project density (projdens) across both dependent variables (crime I and crime II) simultaneously.

A multivariate multiple regression model regresses *two or more* dependent variables on two or more of the same independent variables. Using this structure, my model includes the two dependent variables and the six independent variables outlined in the final POLS regression models already presented.

Multivariate analysis of variance (MANOVA). Prior to conducting the multivariate regression, I ran a multivariate analysis of variance (MANOVA) to test the significance of both equations taken together. The MANOVA model displays the *F*-

ratios and *p*-values for four multivariate criterion, Wilks' lambda (W), Lawley-Hotelling trace (L), Pillai's trace (P), and Roy's largest root (R). In Table 28, the MANOVA output for the model shows *p*-values for all four criterion at 0.0000, indicating the overall model is statistically significant at greater than the predetermined confidence interval of 95% (*p>.0000*).

Table 28

MANOVA Test for Significance of Equations for Crime I and Crime II Together.

	Number of obs =		540			
	W = Wilks' lambda P = Pillai's trace		L = Lawley-Hotelling trace R = Roy's largest root			
Source	Statistic	Df	F(df1,	Df2) =	F	Prob>F
Model	W 0.3019	7	14.0	1062.0	62.21	0.000 e
	P 0.7104		14.0	1064.0	41.87	0.000 a
	L 2.2720		14.0	1060.0	86.01	0.000 a
	R 2.2539		7.0	532.0	171.29	0.000 u
Residual		532-				

Multivariate multiple regression model. Given statistical significance of the overall model, I proceeded to run the multivariate multiple regression model. Table 29 shows the output for this regression model. Although age, education, and unemployment did not show statistical significance in the results of the MANOVA, I retained these variables in the analysis because of their theoretical relationship to community as noted in the previous section that presented and discussed each of the control variables.

The multivariate multiple regression output in Table 29 shows a total of 540 observations. Similar to the results of the MANOVA, the p-values for transformed crime I (log_c1med) and transformed crime II (log_c2 med) show that the univariate models are each significant (*p>.0000*). The R^2 values (labeled in the table as "R-sq") indicate a strong model with 68% of the variance explained by the explanatory/predictor variables

for crime I outcome variable, and 64% of the variance explained by the explanatory/ predictor variables for crime II outcome variable.

Table 29

Multivariate Regression of Crime I and Crime II on Seven Independent Variables.

Equation	Obs	Parms	RMSE	"R-sq"	F	P
log_c1med	540	8	.9687029	0.6828	163.5625	0.0000
log_c2med	540	8	1.138971	0.6398	134.9813	0.0000
	Coef.	Std. Err.	t	P>|t|		Beta
log_c1med						
projdens	.0485034	.0159472	3.04	0.002		.081988
ln_ypop	.0154705	.002634	5.87	0.000		.714604
sqrt_popdens	1.331842	.0563507	23.63	0.000		.1761192
age	.008568	.0080419	1.07	0.287		.0295385
sqrt_edu	.3234568	.589159	0.55	0.583		.015329
sqrt_pov	.90346	.5103691	1.77	0.077		.0546066
sqrt_unempl	-1.05198	.761428	-1.38	0.168		-.0385014
_cons	-6.284523	.5935521	-10.59	0.000		
log_c2med						
projdens	.0414617	.0187503	2.21	0.027		.0635172
ln_ypop	.0176741	. 003097	5.71	0.000		.6802222
sqrt_popdens	1.398854	. 0662554	21.11	0.000		.1823501
age	.0049581	. 0094554	0.52	0.600		.0154913
sqrt_edu	-.3227321	. 6927149	-0.47	0.641		-.0138613
sqrt_pov	1.73844	. 6000762	2.90	0.004		.0952277
sqrt_unempl	-.846793	. 8952635	-0.95	0.345		-.0280873
___cons	-5.99763	. 6978801	-8.59	0.000		
Correlation matrix of residuals:						
	log_c1med	log_c2med				
log_c1med	1.0000					
log_c2med	0.7677	1.0000				
Breusch-Pagan test of independence: chi2(1) =			318.266, Pr = 0.0000			

As anticipated given the results of each regression independently, project density is significant across both dependent variables. The coefficients for project density, population density, and youth population indicate a significant relationship with crime I and crime II at greater than the 95% confidence level. Poverty, however, only shows a significant relationship with crime II. In all significant cases, the relationship is positive meaning that, all things being equal, as each of the predictor variables increases, the

outcome variable increases as well. The beta coefficients also indicate that the effect is minimal, with the most important effect being youth population. The Breusch-Pagan test noted at the bottom of the regression output is significant (0.0000) and confirms that the dependent variables are highly correlated, as pointed out earlier in this section and accounted for in the multivariate model.

Significance testing. Following the multivariate multiple regression, I conducted a test to determine the joint significance of both equations. The results indicate that coefficients as a group are significant across both equations.

```
test [log_median_crime1]

 ( 1)  [log_median_crime1]project_density = 0
 ( 2)  [log_median_crime1]square_root_population_density = 0
 ( 3)  [log_median_crime1]log_youth_population = 0
 ( 4)  [log_median_crime1]age = 0
 ( 5)  [log_median_crime1]square_root_education = 0
 ( 6)  [log_median_crime1]square_root_poverty = 0
 ( 7)  [log_median_crime1]square_root_unemployment = 0

       F(  7,   532) =  163.56
            Prob > F =    0.0000

test [log_median_crime2]

 ( 1)  [log_median_crime2] project_density = 0
 ( 2)  [log_median_crime2] square_root_population_density = 0
 ( 3)  [log_median_crime2] log_youth_population = 0
 ( 4)  [log_median_crime2] age = 0
 ( 5)  [log_median_crime2] square_root_education = 0
 ( 6)  [log_median_crime2] square_root_poverty = 0
 ( 7)  [log_median_crime2] square_root_unemployment = 0

       F(  7,   532) =  134.98
            Prob > F =    0.0000
```

I then tested project density (projdens) across both dependent variables. The null hypothesis for this study is that the coefficients for project density (projdens) in both

equations are equal to 0. The following output shows the results when testing this hypothesis.

```
test project_density

 ( 1)  [log_median_crime1] project_density = 0
 ( 2)  [log_median_crime2] project_density = 0

       F(  2,   532) =    4.64
            Prob > F =    0.0100
```

Since the results of this test (0.0100) are less than the .05 *p*-value (95% confidence interval), I could reject the null hypothesis that the coefficients for project density are equal to zero across both regression equations simultaneously. Based on this analysis, the coefficients for project density would be considered statistically significant when taken for both outcomes together. However, the STATA Manual suggests a more conservative approach that considers the number of independent variables in the regression model (StataCorp LP, 2015, p. 554). Testing this approach, I divided the .05 *p*-value (95% confidence interval) by the number of independent variables in the regression model (7) to get 0.00714. The results of this test (0.0100) under this more conservative approach are greater than 0.00714, indicating that the coefficients for project density are *not* statistically significant across both outcomes. Although this conservative approach suggests that I *cannot* confidently reject the null hypothesis, other conservative approaches suggest otherwise. Given the context of applied research within social sciences, where an infinite number of factors may influence outcomes, social researchers are better off using a 90% confidence interval in lieu of the 95% confidence interval used in basic research methods (Judd & Kenny, 1981). Using the 90% confidence interval along with the recommended conservative approach from the STATA Manual, the

coefficients for project density are statistically significant when taken for both outcomes together.

Finally, I tested the null hypothesis that the coefficient for the predictor variable, project density, in the regression equation using log_cr1med (transformed crime I) is equal to the coefficient for project density in the regression equation using log_cr2med (transformed crime II). The null hypothesis is that the difference in the coefficients is 0, or that both coefficients are equal.

```
test [log_median_crime1] project_density = [log_median_crime2] project_density

(1)  [log_median_crime1] project_density - [log_median_crime2] project_density = 0

           F(  1,   532) =    0.34
                Prob > F =    0.5613
```

The results show that the coefficients are not significantly different; therefore, I accept the null hypothesis that the difference in the coefficients is zero. This result indicates that the difference between the coefficients for project density in the equation with crime I and crime II as the dependent variables is not significantly different from zero such that the effect of project density on crime I is equal to the effect of project density on crime II.

Conditional effects. To take this analysis further, I graphed the conditional effects for different project density values on both crime 1 and crime 2 relative to the three significant control variables, youth population, population density, and poverty. The lines in Figures 29 through 31 represent the different predictive values for project density (projdens) at four different levels (50^{th} percentile, 75^{th} percentile, 95^{th} percentile, and 99^{th} percentile). I calculated these predictive values from the regression analyses, which involved transformed variables. To acquire a better understanding of the effects, I

generated the graphs in terms of the original values by inverse transforming the predicted values and graphing them over the original values for each control variable. In the graphs below, the predicted values for project density are set at the respective four levels while allowing the variable of interest to vary and holding the other variables at their median. Only three lines are visible in the Crime 1 graph depicting project density over youth population because the project density value at the 50th percentile essentially has an effect that does not differ from that of the 75th percentile. The other graphs, however, delineate all four levels of project density. The entire series of conditional effects plots indicates that it takes a relatively high project density value to have a marked effect on crime, yet the graphs do provide a visual confirmation that project density is likely to influence crime within communities. They also indicate that as youth population, population density, and poverty rate increase, high levels of project density have a more pronounced effect.

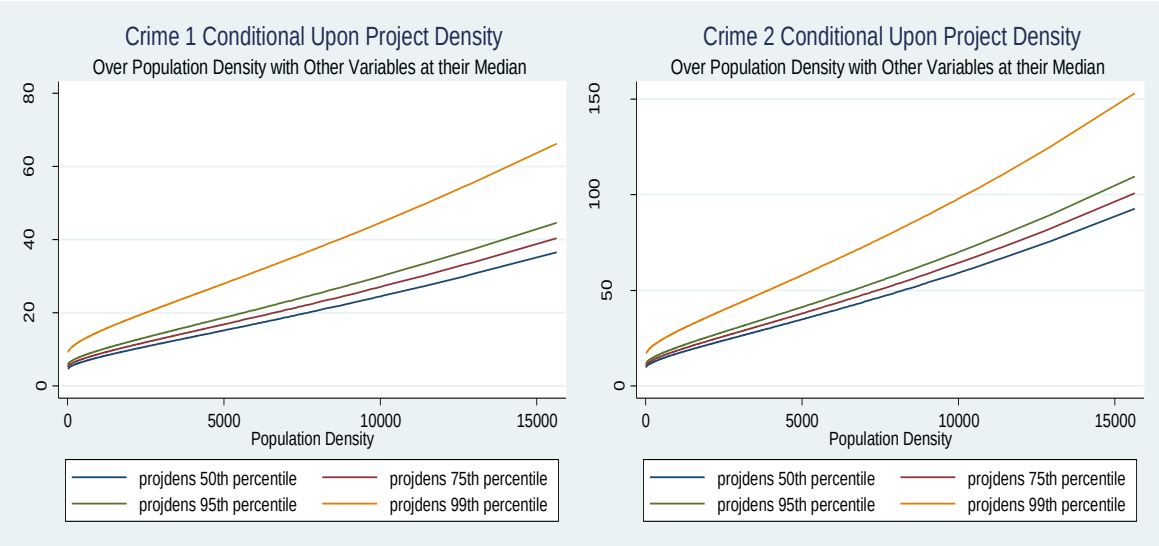

Figure 29. Conditional effects graphs - population density.

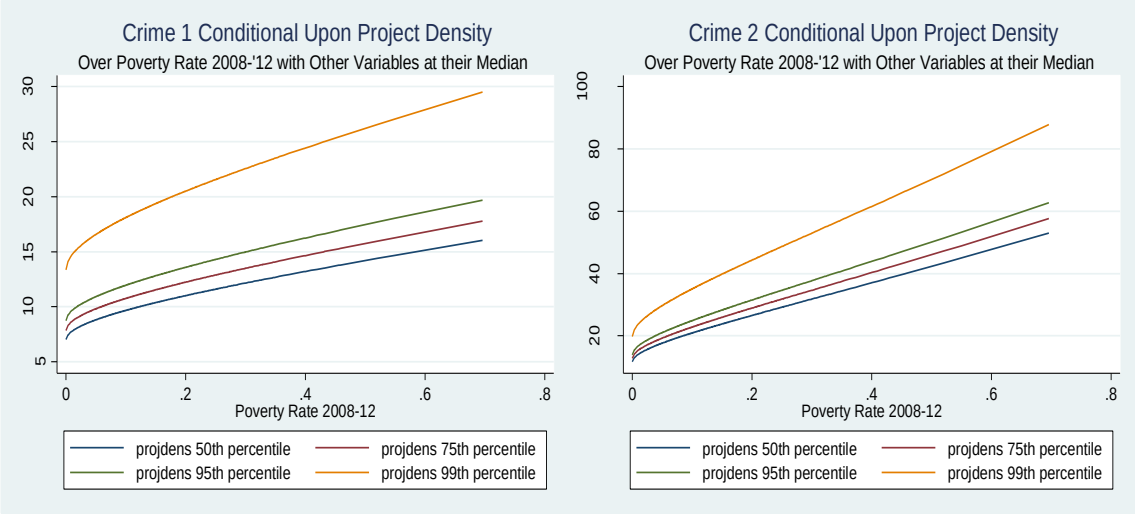

Figure 30. Conditional effects graphs – poverty rate.

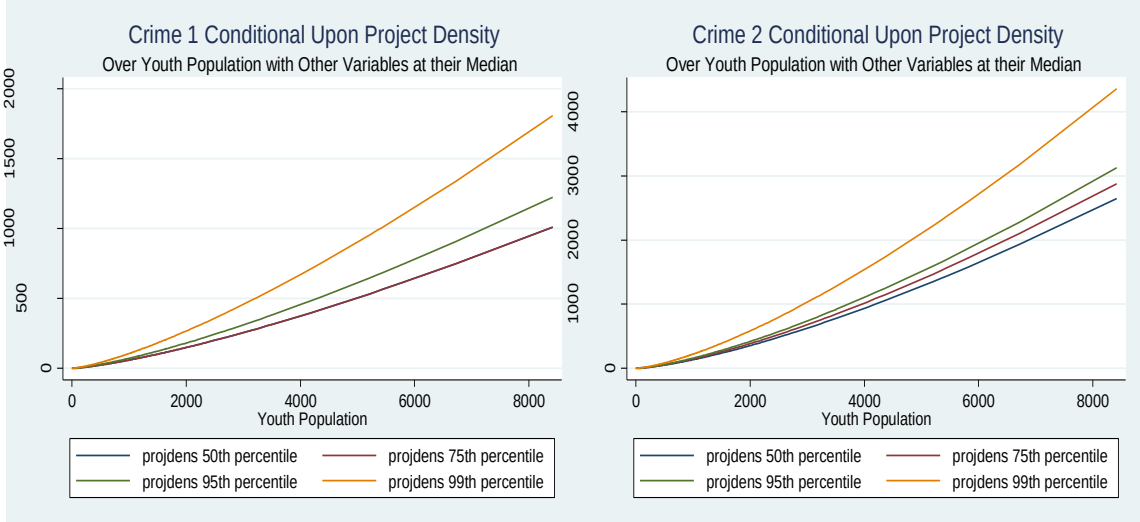

Figure 31. Conditional effects graphs - youth population.

Statewide Quantitative Analysis Findings

The findings for this statewide quantitative analysis show that project density has an effect on both crime I and crime II. In both cases, this effect is significant, but minimal, rejecting both null hypotheses that no relationship exists. Based on the strength and direction of the coefficients, the relationship between project density and crime is positive: as project density increases by 1, crime I (ln_c1md) increases by .0485034 and

crime II (ln_c2md) increases by .0414617. While these increases are slight, they are positive as opposed to negative. This outcome is contrary to what I had anticipated about the effect that transportation infrastructure may have on criminal behavior in communities.

While the effect seems in practice minimalistic, the significance of the relationship remains important. This effect suggests that transportation does in fact have an effect on crime. More importantly, the effect exits without attending to engineering design that might alter criminal behavior. It seems reasonable to consider a deliberate engineering effort to target the reduction of criminal behaviors could provide a more substantial effect in the desired direction. In particular, this may prove reasonable where transportation projects are engineered and targeted toward population and youth population in particular. This perspective follows previous engineering efforts to re-purpose these public spaces. For example, traditional transportation engineering increased traffic efficiency, but after considering community characteristics and needs, re-engineering of streets came into vogue as communities identified mixed-use opportunities. These projects proved very successful. In their book, *Rethinking Streets: An Evidence-Based Guide to 25 Complete Street Transformations,* Schlossberg, et al show the impact re-designing streets for broader applications from on-street parking and one-way traffic patterns, to adding bicycle corridors, pedestrian connectivity, and streetscaping initiatives (Schlossberg, Rowell, Amos, & Sanford, 2013). Additionally, in their 2016 report of *The Best Complete Streets Policies of 2105,* the National Complete Streets Coalition demonstrates the increasing popularity in re-engineering our city streets (National Complete Streets Coalition, 2016). The number of national Complete Street

Policies intended to create safer multi-modal transportation networks is on a rise, growing from 32 policies in 2005 to 889 policies in 2015 (National Complete Streets Coalition, 2016, p. 4)

Case Study: Borough of Penbrook

This segment of the chapter focuses on the analysis and findings of the case study encompassed in the larger, mixed-methods study. The case study involved a single municipality, the Borough of Penbrook, where the community focused on reducing criminal behavior as part of the transportation improvement project. This phase of the study was completed and is presented in two parts. Part A provides a discussion on the quantitative analysis and findings relative to criminal and deviant behavior within the borough before, during, and after the completion of a transportation infrastructure project. Part B provides a qualitative analysis of the perceptions of municipal police, employees, and business owners regarding changes in criminal behavior after the project completion. The goal of this two-part case study is to compare the results with the findings observed in the statewide analysis in order to triangulate converging evidence and strengthen the overall research findings. In addition, this case study provides findings that further explore and explain the nature of the relationship between transportation infrastructure and criminal behavior and determine if it is causal.

Overview of the Project

The Borough of Penbrook is a small suburban community in Dauphin County. Penbrook encompasses about 4 tenths of a square mile, sits adjacent to Pennsylvania's capitol city of Harrisburg, and has a population density of 6,735. The borough's population has declined since its 1960's high of 3,671, dropping to 2,990 in 2012

according to projections from the 2010 census (U.S. Census Bureau, 2016). Race percentages for the borough include 64% white, 31% black, and 5% other. Table 30 provides additional demographic information and provides a comparison with median Pennsylvania statistics obtained from the 2014 Municipal Profile.

As the table shows, Penbrook has a larger non-white population, larger youth population, and lower median age. There are more renters than homeowners and the median housing value is only about two thirds of the median housing value in Pennsylvania. Median household income and per capita incomes are lower than the statewide median, while poverty and unemployment rates are higher.

Table 30

Borough of Penbrook Demographic Comparison

Penbrook Demographics Compared with Statewide Numbers		
	Penbrook	PA Median
Population Density	6,735	283.9
Race – White	63.9%	82.5%
Non-white	36.1%	17.5%
Youth Population	29.9%	21.9%
Median Age	33.9	40.1
Median House Value	$112,600	$164,900
Homeowners	51.7%	70.1%
Renters	48.3%	29.9%
Persons with High School Diploma or GED	44.4%	37.2%
Persons with Bachelor's Degree or Higher	15.7%	27%
Median Household Income	$35,625	$52,267
Per Capita Income	$19,952	$28,190
Poverty	16%	13.1%
Unemployment	10.8%	8.5%

Penbrook's roadway transportation layout is unique because five major roadways run through its borders. These roads connect the neighboring city with the suburbs beyond Penbrook and so the borough experiences a disproportionate share of through traffic. Increased traffic can bring business to communities; however, it also brings congestion and aggravation. As noted in a proposal submitted to the Borough of

Penbrook by the Buchart Horn engineering firm, "While a high volume of through traffic is potentially good for local businesses, when the state route corridors become congested, transient and through traffic increasingly utilizes the local roadway network as 'cut-throughs', which benefits neither business nor residential quality of life…. The increase in traffic on the local roads decreases safety, increases crime, and diminishes the overall positive character of the neighborhoods" (Buchart Horn, Inc., 2007, p. 17).

The purpose of the project was to "evaluate and improve traffic flow through the Borough of Penbrook in an effort to reduce crime and traffic congestion, and increase residential and business parking… Based on the changes in traffic patterns proposed as part of this project, we believe that a reduction in the number of transients who have both the opportunity and the familiarity to consider criminal activity will occur. While not all crime is committed by transients, reducing transients should produce a quantifiable reduction in opportunity, thereby resulting in an overall decrease in crime (Buchart Horn, Inc., 2011, pp. ES-1)."

To effect these changes, Penbrook officials implemented a traffic redesign project. The improved traffic redesign project sought to achieve the following goals (Buchart Horn, Inc., 2007, p. 17):

1. Reduce "transient" and "cut-through" vehicle traffic on the Borough residential streets
2. Provide safe non-motorized transportation opportunities for the community
3. Maximize the safe and efficient movement of motorized transportation
4. Improve vehicle-parking opportunities in the business and residential areas

To effect this redesign, the project scope included a combination of one-way street pairs to eliminate short-cut possibilities; traffic calming devices to slow traffic, discourage non-local traffic, and make state routes the preferred commuter routes through the borough; and crime prevention lighting for vehicular and pedestrian traffic. The project began in February of 2007 and was completed in August of 2008. Figure 32 shows a map of Penbrook with the project improvements notated.

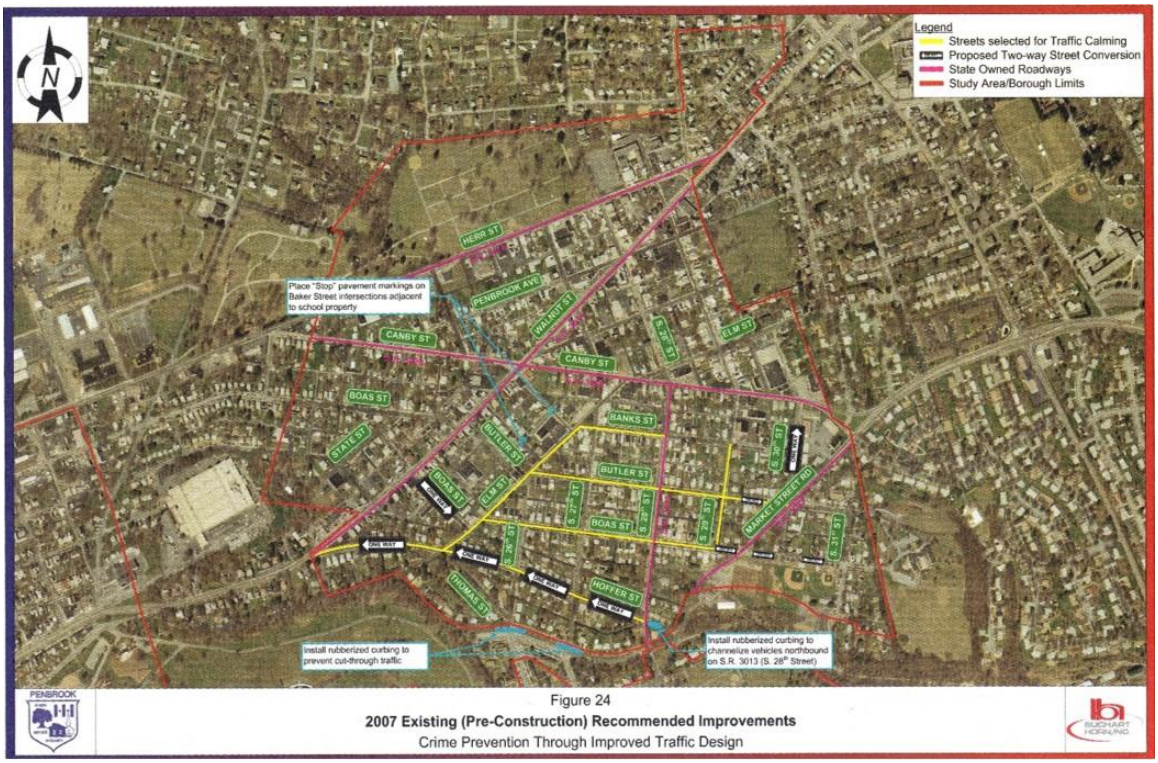

Figure 32. Map of Penbrook with project improvements.

Part A: Quantitative Analysis

Penbrook crime data. To test the theory that transportation infrastructure may reduce criminal behavior, and to explore the effects of this specific transportation infrastructure project, I conducted a case study using the Borough of Penbrook. This case study employed quantitative and qualitative data analysis. For the quantitative analysis, I

reviewed crime secondary data on crime reported by the Borough of Penbrook Police Department. These statistics ranged from 2006 through 2010, and overlapped the borough's transportation infrastructure project completed in 2007.

Using simple time series analysis as an analytic tool (Yin, 2003), I examined crime data before the project with crime data after the project was completed. Similar to the statewide analysis, these crime statistics are broken down into Parts 1 & 2. Figure 33 shows an interruption to the rising crime trend and a clear drop in overall Part I crime from 2007 to 2008, which was when the study project was completed. Specifically, rape, assaults, larceny motor vehicle theft, and arson dropped during this period. Robberies and burglaries increased during this period, however.

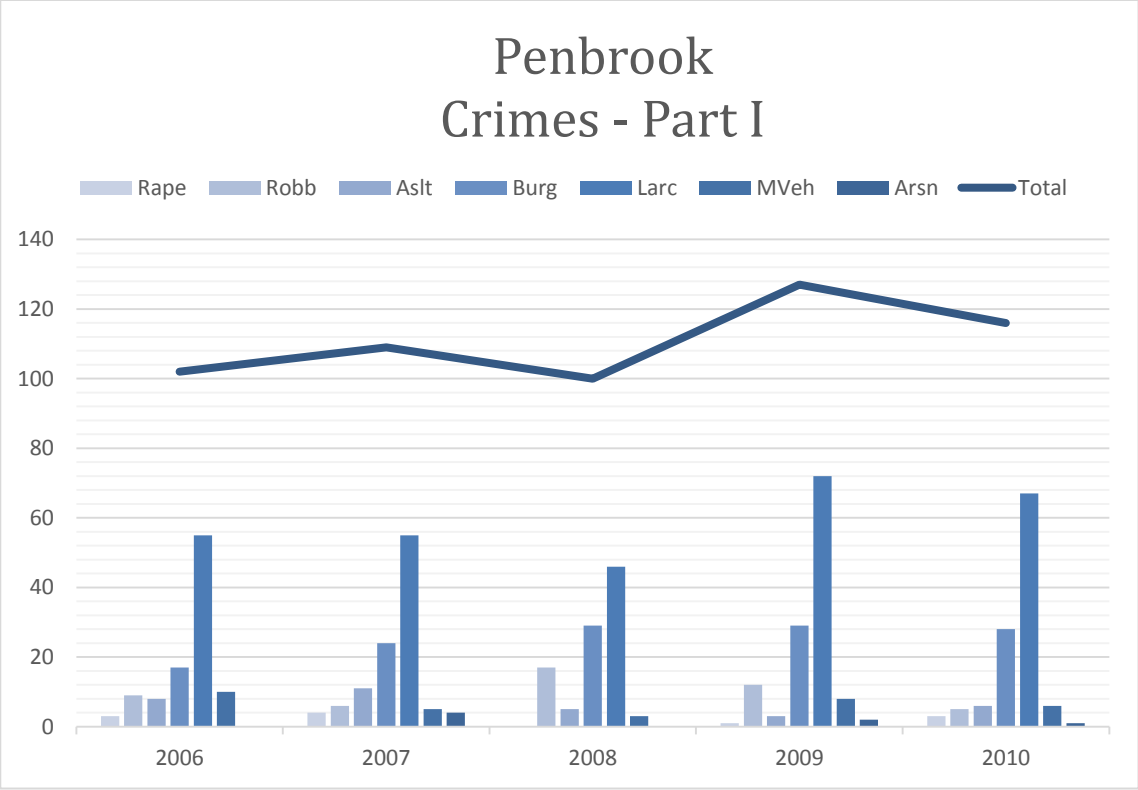

Figure 33. Part I crimes reported in Penbrook between 2006 and 2010.

Figure 34 shows a continued increase in Part II crime through 2008 and then it tapers off, declining through 2010. More specifically, vandalism and vagrancy see the greatest declines over this period.

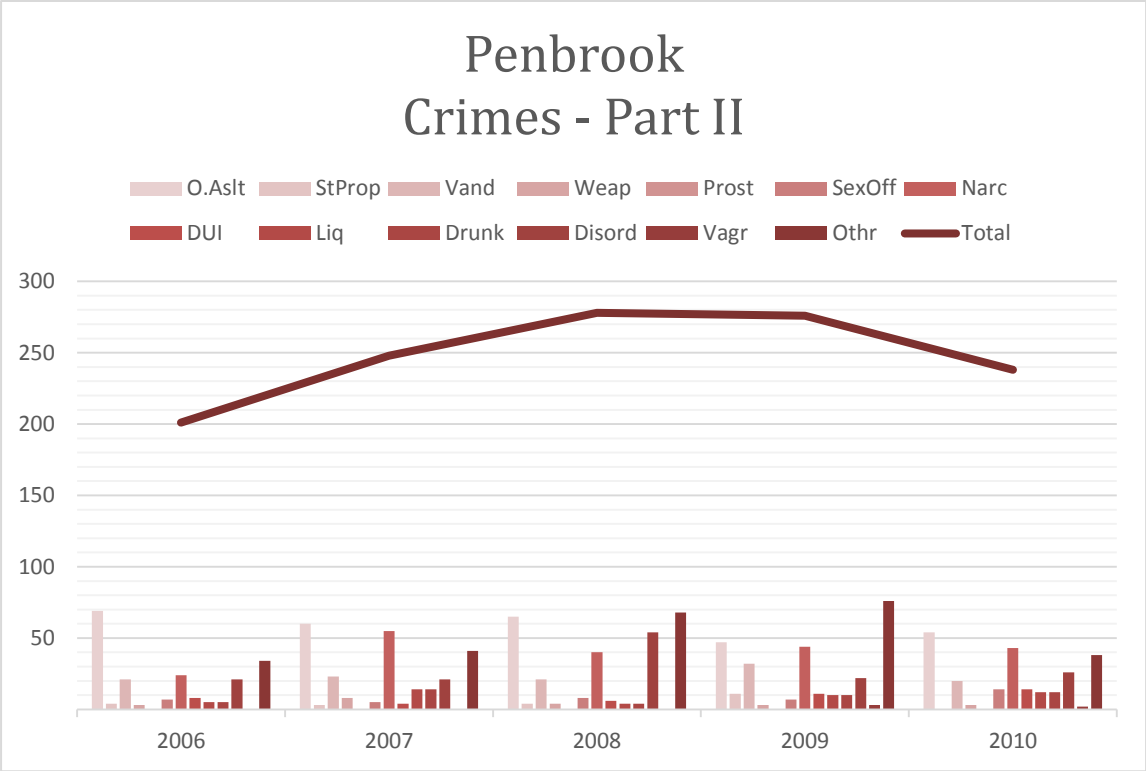

Figure 34. Part II crimes reported in Penbrook between 2006 and 2010.

I compared Penbrook's annual crime data for crime Parts I and II with crime data from other Pennsylvania boroughs to further assess the potential that this infrastructure project had an effect on crime. Figures 35 and 36 show this comparison for Crime I and Crime II respectively. I included in this comparison a single borough, Sharon Hill, with similar demographics as Penbrook, yet it had no transportation infrastructure projects during the same period. In addition, I compared crime data medians for all boroughs statewide, all boroughs that completed at least one project, and all boroughs that had no projects. For all statewide measures, the trends are declining slightly over the five-year period.

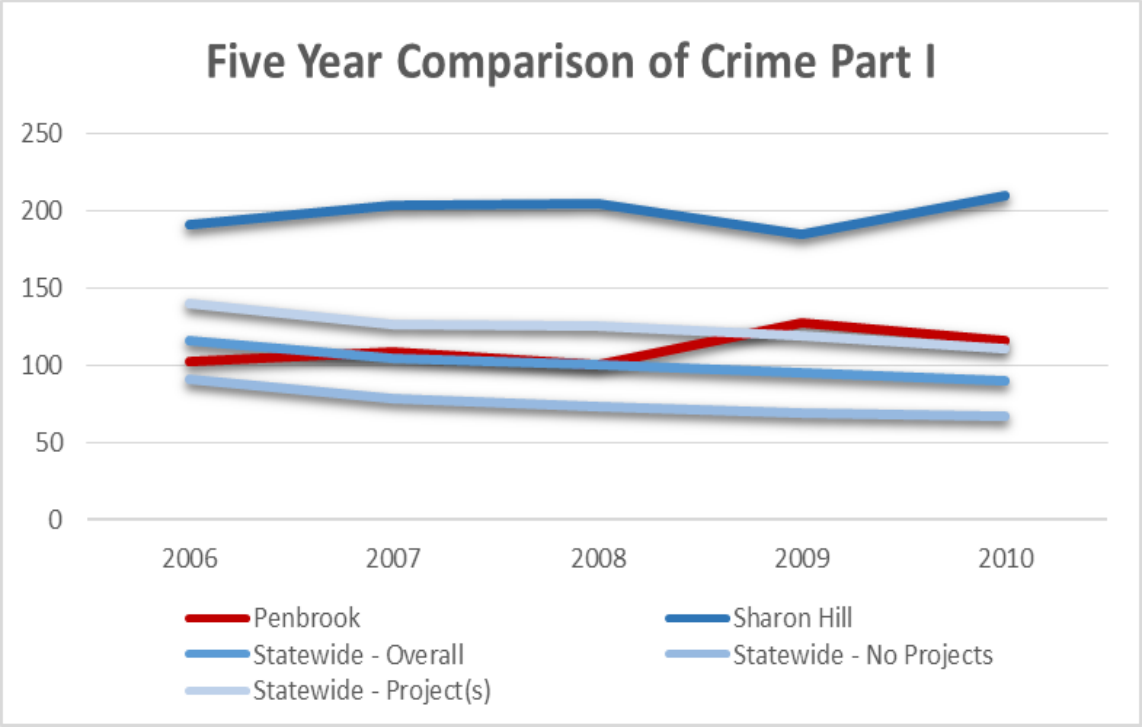

Figure 35: Comparison of crime I with other Pennsylvania boroughs.

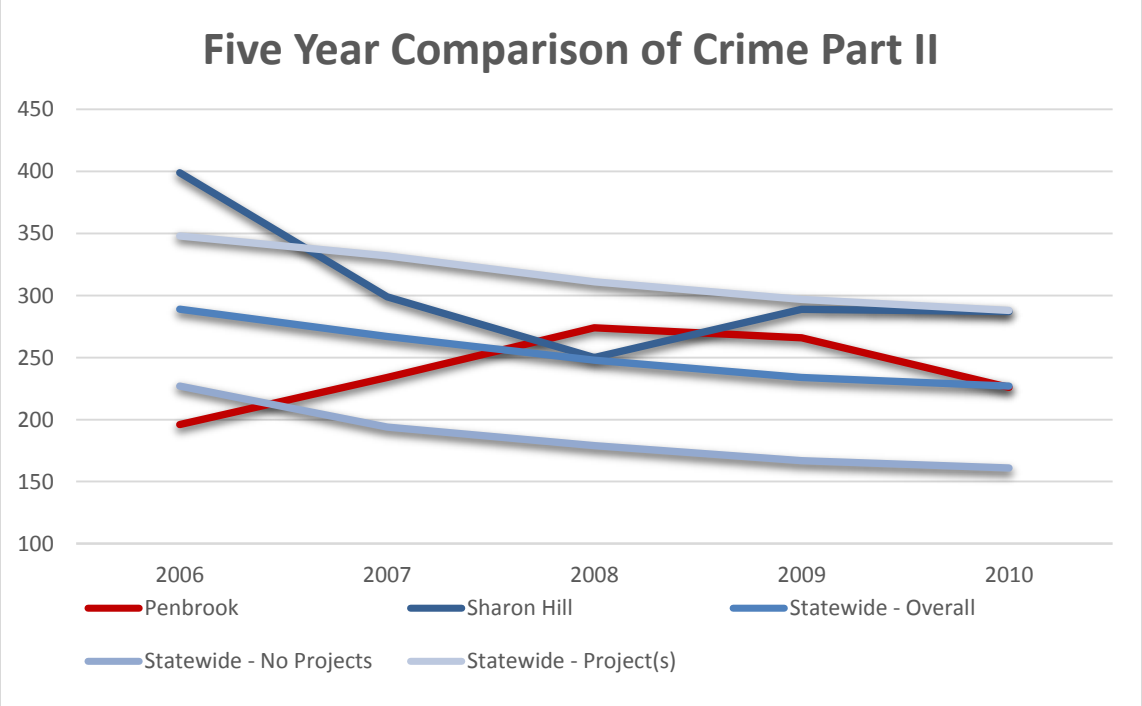

Figure 36. Comparison of crime II with other Pennsylvania boroughs.

Comparisons between Penbrook and Sharon Hill show an almost inverse effect relative to each other. In both cases, crime rises in Penbrook when it declines in Sharon Hill, and vice versa, which appears similar to the results uncovered through the statewide quantitative analysis. The results, however, are not definitively clear as to whether the variations in criminal behavior are in response to infrastructure changes within the community. These variations in criminal behavior can be attributed to a number of factors, most of which are beyond the scope of this study, however infrastructure project activity may be among them among them.

Penbrook incidents and complaints. In addition to the actual crimes reported for the entire borough, I also analyzed the frequency of incidents and complaints reported to the borough police department before and after the project. This data was only available for Penbrook. Therefore, I was unable to make incident and complaint comparisons with other boroughs as part of this study.

The Penbrook Police Department subdivides the borough into nine separate policing areas to monitor and track activity and dispatch officers for surveillance. Figure 37 shows how these nine separate areas for policing are delineated within the borough. The police department reports crimes as well as the number of incidents and the number of complaints by these policing areas. The data used for this analysis are broken down by these policing areas to allow for specific analysis.

Incidents. Since the project took place during 2007, I looked at incidents from 2006 (pre-project) through 2010 (post-project) using the same simple time series analysis as I used for crime to compare pre- and post-project numbers. I also looked at overall

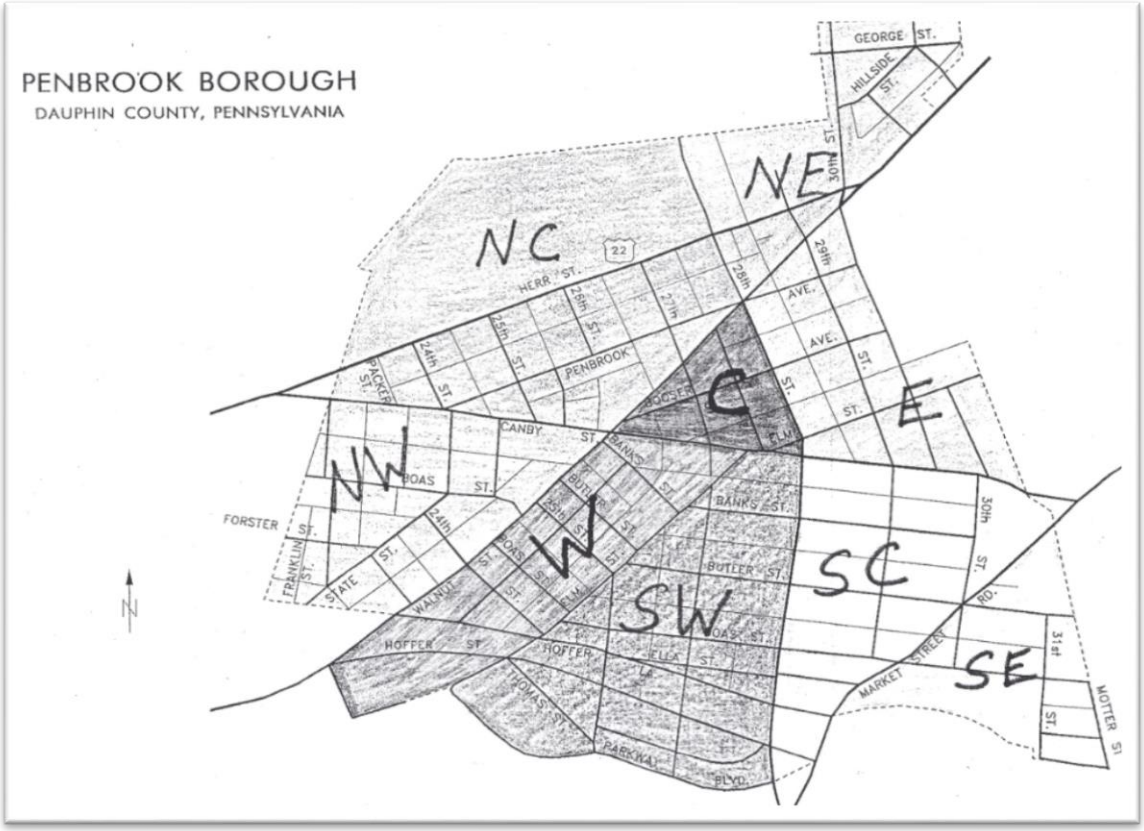

Figure 37. Map of Penbrook policing areas.

number of incidents in the borough, incidents by areas within the borough, and then incidents specific to the areas affected most by the traffic redesign project. Overall, incidents in the borough dropped significantly in 2008. However, they began to rise to nearly pre-project numbers by 2009 as shown in Figure 38. Figure 39 presents this data by area within the borough.

Based on this figure, it appears that the numbers of incidents by area changed after the project completion. Although the overall number of incidents appears to regain its pre-project totals, the numbers in the center area rise over time and the southeast and southcentral policing areas show an overall decline over time. This may suggest that these activities are shifting from one "hot spot" to another, which was not able to be accounted for in the statewide quantitative analysis.

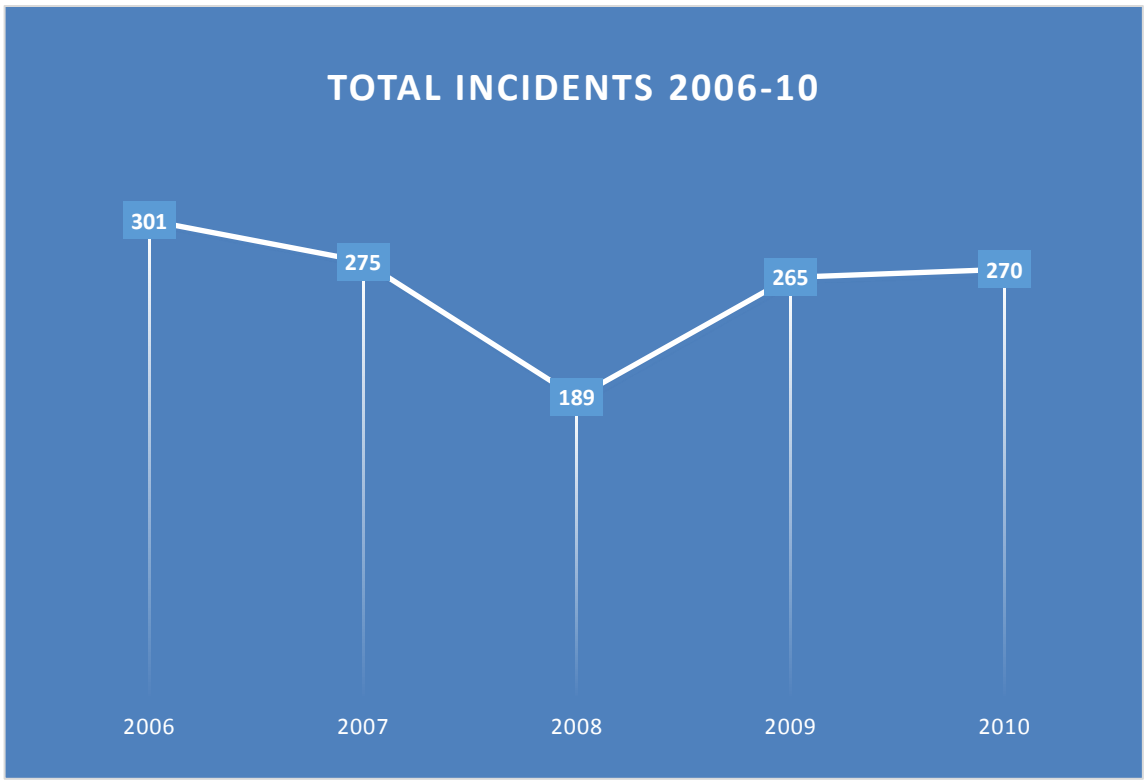

Figure 38. Total incidents reported in Penbrook between 2006 and 2010.

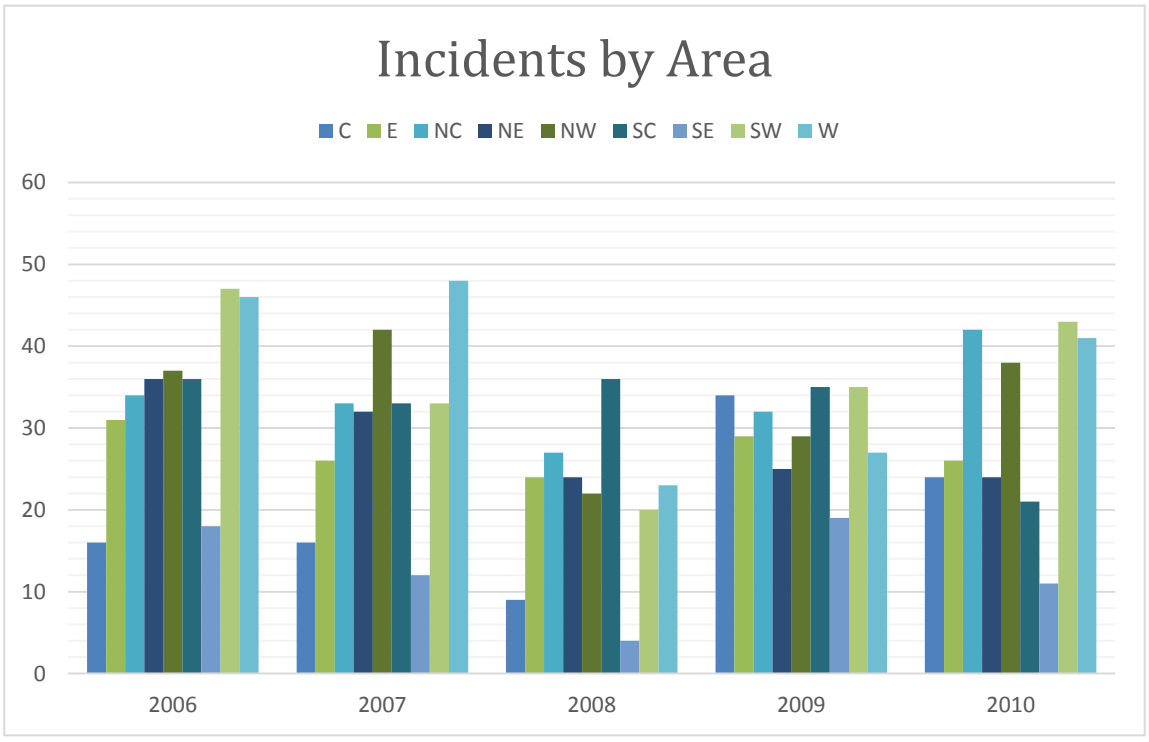

Figure 39. Total incidents reported by policing area between 2006 and 2010.

Figure 40 specifically focuses on the southwest and west policing areas that were affected by transportation project interventions. In these cases, the number of incidents drop significantly in both the areas immediately after project completion as reflected in the 2008 numbers. Both areas show an increase in 2009 and 2010 similar to the number of complaints. Despite this increase, the numbers in 2010 remained lower than the pre-project totals in 2006.

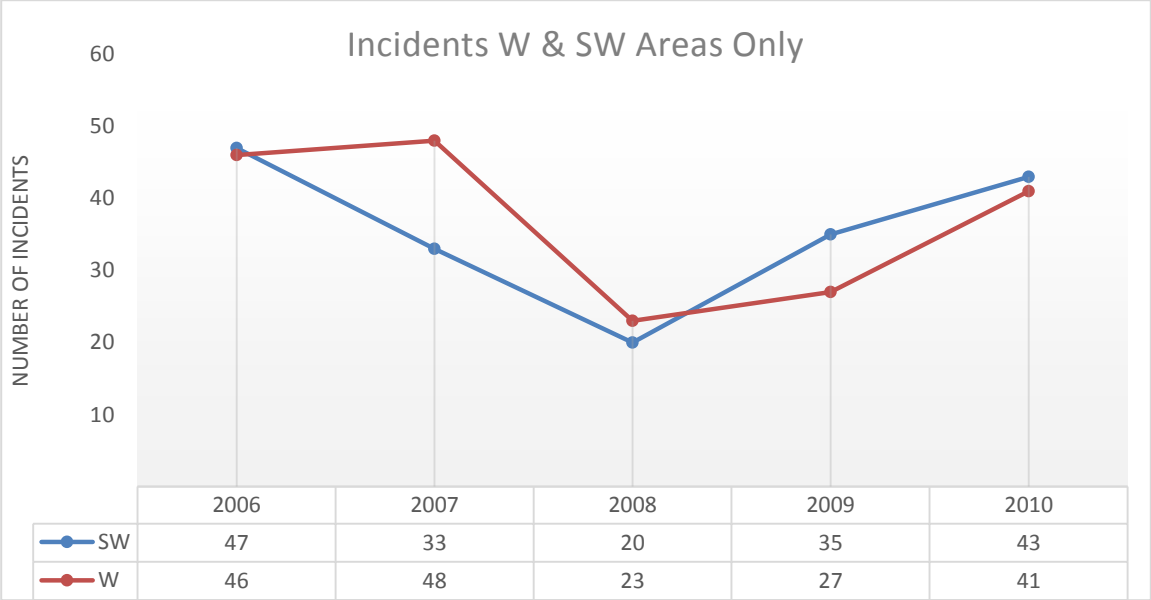

Figure 40. Incidents reported in west and southwest areas.

Complaints. Similar to my analysis of incidents, I looked at the overall number of complaints in the borough from 2006 (pre-project) through 2010 (post-project) by areas within the borough, and then complaints specific to the areas affected most by the traffic redesign project. Figures 41 shows the overall number of complaints declined from 2,422 in 2007 to 2,314 in 2008, and ultimately to 1,855 in 2010. Figure 42 shows these statistics by policing area, indicating the variance from one area to the next.

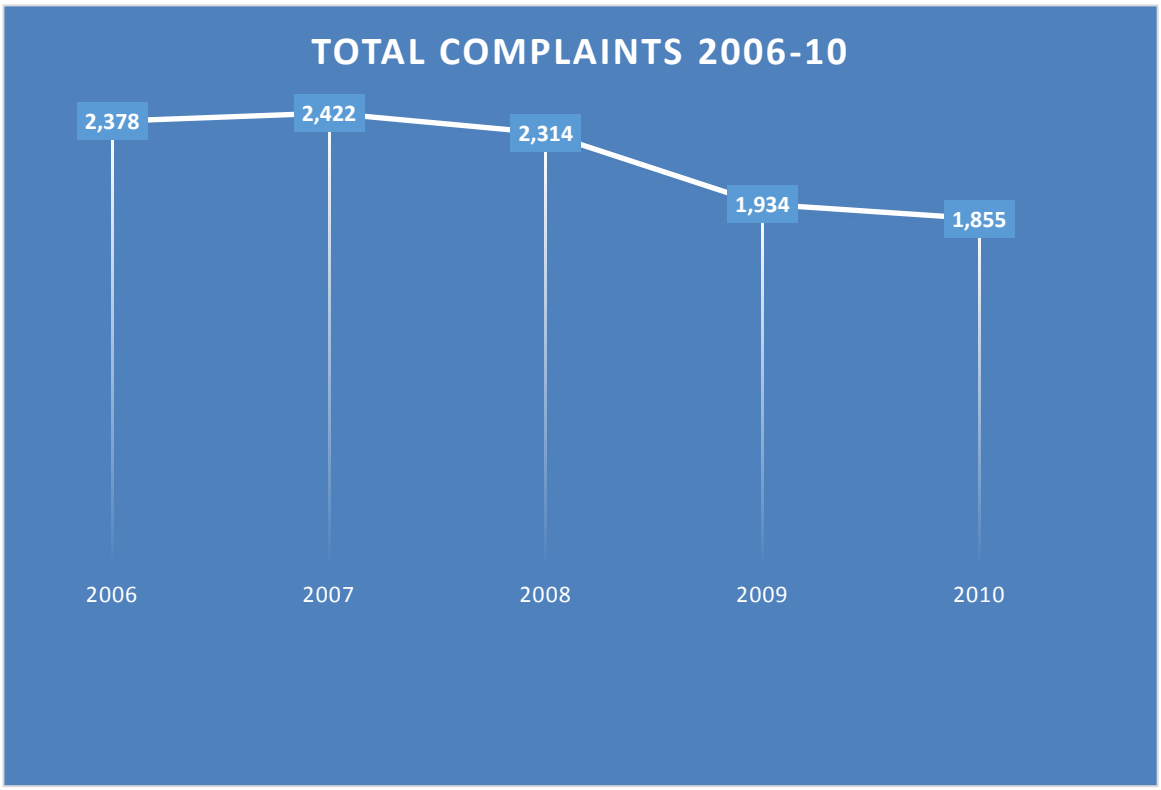

Figure 41. Total complaints received in Penbrook between 2006 and 2010.

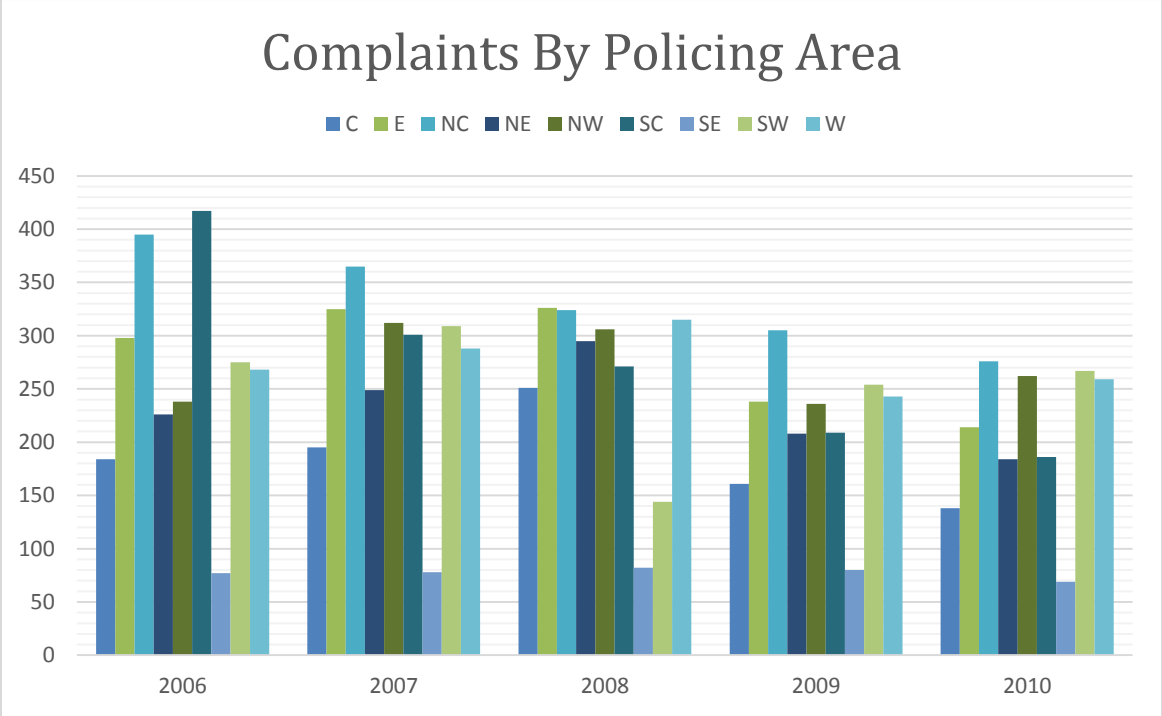

Figure 42. Total complaints by policing area received between 2006 and 2010.

The largest decline in complaints occurred in the northcentral and southcentral areas, which were less affected by the project activity. Since the majority of the transportation infrastructure changes occurred in the areas noted as west and southwest, I took a closer look at the complaints that were reported in these areas specifically. Figure 43 shows that the number of complaints in 2008 dropped significantly in the southwest area but not at all in the west area. In fact, complaints actually rose in the west area in 2008. In 2009, however, the number shifts in both areas, yet both remain lower than pre-project numbers through 2010.

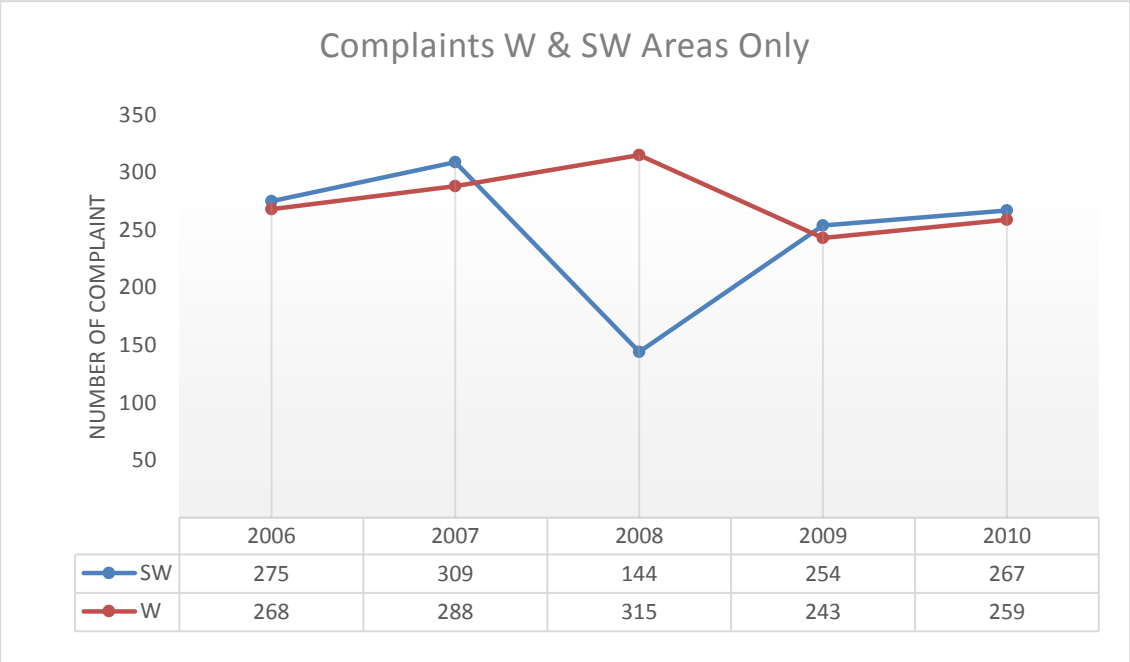

Figure 43. Complaints received in west and southwest areas.

The findings of this quantitative analysis clearly show that criminal activity, as well as the number of incidents and complaints, dropped during and shortly after the transportation infrastructure project was complete. This drop is more prominent in policing areas that are geographically closest to the project. In some cases, the drop remained while in others a slow climb upwards after the project began, yet never reached

pre-project levels. The number of complaints may not only indicate increased deviant activity but also more awareness of this activity in response to other changes such as increased lighting or traffic patterns.

Part B: Qualitative Analysis

One-on-one interviews. While the quantitative analysis was helpful in estimating potential effects on crime due to this transportation infrastructure project, one-on-one interviews with individuals familiar with community life in Penbrook provided more insight. It was important to meet with individuals who have a day-to-day familiarity with life in the Borough of Penbrook before and after the project was completed. Based on this criteria, I selected police officers, business owners, and public works employees for the interviews.

Sampling frame. With the help of the Penbrook Chief of Police, who has worked with the Penbrook Police Department for 37 years and served as a champion for the traffic redesign project, I narrowed these groups to individuals who were employed or in business prior to the project, throughout the project period, and after the project was completed. In total, I interviewed eight police officers, ten business owners, and two public works employees for a total of 20 respondents. All of these respondents worked within the borough limits, although some worked closer to the project areas than others. To conduct the interviews, I met one-on one with each individual on site at their place of work to ensure the least interruption of their time. I used the interview guide and questions found in Appendix A to guide the interviews and questioning while capturing responses on a laptop computer.

Data collection and analysis. I analyzed the responses collected during the interviews with borough employees and business owners using a general coding strategy. This strategy was based on the theoretical proposition that transportation infrastructure projects can serve as an intervention that results in a reduction in criminal behavior. I used a pattern matching method that compares patterns observed empirically with a predicted pattern or theoretical proposition (Yin, 2003). This analytic approach is suggested by Robert Yin in his Book, *Case Study Research*, as one technique for case study analysis. Since I am not attempting to construct a complex theory, this simplified analytic approach is ideal for trying to understand what occurred during the study timeframe.

Using this pattern matching method to gauge the perception of the effect that the transportation infrastructure project had on the Penbrook community, I assigned the responses regarding change after the project to one of three groups. These groups were determined based on patterns relative to the underlying theoretical proposition that transportation infrastructure projects can produce changes that result in reduction in criminal behavior. Responses that supported this proposition (pattern 1) were assigned to Group A. Those that did not support this proposition (pattern 2) were assigned to Group B. Those that neither supported nor refuted the proposition (pattern 3), were assigned to Group C. For example, a response indicating that the frequency of nuisance crimes has decreased since the project was completed was assigned to Group A. Responses indicating that criminal activity has not changed either way, for the good or bad were assigned to Group B. If the respondent was unsure or "hadn't paid much attention", their response was assigned to Group C.

The responses in each group or pattern were then totaled, resulting in overall scores or strengths for each group. These scores show the number of responses that were coded or grouped similarly and represent the strength of the pattern for each response. The group totals indicate the overall perception of the effect that the transportation infrastructure project had on changes in community.

Table 31 shows a summary of the topic map focus areas grouped according to their related questions. In order to quantify the descriptive elements of this case study, I noted the number of responses for each question regarding "change after project completed." These responses reflect the perception whether the item being measured (types of criminal activity, types of offenders, etc.) did or did not change after the project was completed.

The results show that the total for Group B, responses that did not support the proposition, represents 73% of the responses. In all topic areas, the subtotal scores indicate that the majority of the respondents, in general, *did not perceive* that the transportation infrastructure project resulted in any changes in the community. This finding suggests that the theoretical proposition is wrong, that the results fail to show that transportation infrastructure has no effect on criminal behavior as predicted.

However, 22% of the responses are represented in Group A, supporting the theoretical proposition that transportation infrastructure projects can produce changes that result in reduction in criminal behavior. In several specific cases, the respondents clearly felt that the project did result in changes that actually reduced criminal behavior. Noting the proximity to the project location, the respondents who felt that the changes had an effect on criminal behavior were those who worked nearest the location of the project and

were more likely to observe the day-to-day effects of the project. Based on their responses and the proximity to the project location, these responses suggest that, in fact, the changes in transportation infrastructure can reduce crime in the immediate area of the project.

Table 31

Summary of Topic Map Focus Areas and Related Questions.

Summary of Response Groupings				
Topic Map Focus	**Interview Question Topic**	**Supported Pattern A**	**Group Unsupported Pattern B**	**Neutral Pattern C**
Incidents of Criminal Activity	Aware of criminal activity Types of criminal activity Level of severity of crimes			
	Change after project completed	3	9	1
	Types of offenders			
	Change after project completed	4	11	1
	Location of criminal activity			
	Change after project completed	6	9	1
	Frequency & patterns of criminal activity			
	Change after project completed	2	13	1
	Subtotal	*9*	*22*	*1*
Sense of Security	Personal safety			
	Change after project completed	2	13	1
	Safety of property			
	Change after project completed	2	14	0
	Subtotal	*4*	*27*	*1*
Guardianship	Community Pride			
	Change after project completed	3	12	1
	Guardianship/Willingness to protect			
	Change after project completed	6	10	0
	Subtotal	*9*	*22*	*1*
TOTALS		**28**	**91**	**6**

Explanation building. Explanation building is a specific type of analytic used for case study analysis in explanatory case studies (Yin, 2003). I used this technique to further analyze the case study data in the pattern matching analysis above and to build an explanation for the responses noted. Table 32 summarizes the qualitative responses that I observed throughout the interview process. I derived these summaries from a collection

of individual responses to each of the questions. The questions relate back to the Topic Map discussed in Chapter 3, Figure 5, which explains how each of these questions supports the theoretical proposition. The summary of responses noted in the table are consistent with the pattern matching analysis, indicating that, while the changes were not substantial, several of the respondents did believe that changes in criminal behavior had occurred after the transportation infrastructure project was completed. These summaries provide a set of causal links that, while difficult to measure, help to explain the results of this study.

The results in this case study come from just one project in one community. The impact that this one project had is difficult to assess thoroughly. The respondents represent individuals from parts of the borough with varied exposure to the actual project. Their perspectives regarding the effects of this project on criminal behavior, therefore, are dependent on their proximity to the area where the project took place. Those nearest the project clearly noticed changes in criminal activity while those farther away were not impacted and therefore reported no significant changes.

Through the interviews, I also attempted to observe and qualify changes in the community's sense of security and guardianship. The results showed no change in either sense of security or guardianship resulting from the project. In both cases, the majority of respondents felt good about their community regardless of the improvements that were made.

Table 32

Summary of Qualitative Responses.

Topic Map Focus Area	Interview Question	Summary of Responses
Community Perspective	Role in community	Police Officers and Business Owners
	Perception of changes	Most were familiar with the referenced project
Incidents of Criminal Activity	Types of criminal activity	Mostly nuisance crimes, drug activity, and thefts. Culprits are juveniles and young adults with some transient and non-resident activity. Traffic stops and nuisance crimes have gone down in the immediate area due to changes in traffic patterns. Limited access appeals to more stable tenants not prone to criminal activity. No change in other areas farther from the project location.
	Location of criminal activity	Noticeable "hot spots" before the project were at "Little Valley" and around the 7-Eleven, These locations were not near the project site. No noticeable changes were apparent after the project was completed.
	Frequency of criminal activity	Most felt that crimes and incidents were occasional, a few from time to time or weekly. Generally, no noticeable changes were apparent after the project was completed. The frequency decreased on the nuisance crimes along with the criminal interdiction type activity in that area.
Sense of Security	Personal safety	No concerns about personal safety. Only concerns have to do with nearby city. A sense of personal safety improved somewhat in the areas near the project location. Some expressed that the changes did improve their sense of safety because juveniles were no longer hanging out on the corners.
	Safety of property	Generally no concerns about the safety of personal of community property. Many respondents do not live in Penbrook, however. Changes yielded less traffic, fewer accidents, less drunk driving, hit and runs, etc., especially in the areas the project focused on. Before the project, there was more opportunity vandalism and crime.
	Safety of visitors	Feel that visitors for business and social are safe, particularly during business hours.
Guardianship	Pride	Most expressed a sense of pride in community and felt that this feeling is shared among members of the community. This improved somewhat toward the end of the project. Some felt there was no change while others felt that it helped make it better, a little quieter
	Willingness	Most expressed a willingness to protect that is common among those who are a part of the community. Not felt among transients. The community has changed but not necessarily a result of the project. Areas that saw a decrease in traffic due to the new traffic patterns, however, did see improvements. The project was an advantage to the areas affected but can't completely attribute any changes to the project itself.

Chapter Summary

In this chapter, I presented the results of both a statewide quantitative analysis and a case study analysis regarding the effect that improvements in transportation infrastructure have on criminal behavior. The results from both analyses complement each other and suggest opportunities for both future research and transportation engineering. In the statewide analysis, we saw that project density did have an effect on crime I and crime II categories of crime, although the effect was in the opposite direction from what I theorized and expected as project density increased so did crime. In the case study analysis, however, the police reports show that crime, incidents, and complaints all declined after the transportation infrastructure project was completed. Finally, the qualitative analysis involving interviews with borough representatives showed a mix of responses depending on proximity to the project. While most respondents did not perceive the project had any effect on criminal behavior, those closest to the project location perceived a reduction in criminal activity. In the next chapter, I elaborate on these findings in relation to the literature.

CHAPTER V

DISCUSSION AND CONCLUSIONS

This study explores the influence of transportation infrastructure on criminal behavior in an effort to identify ways for communities to maximize available public resources. Should such a relationship exist, transportation may play a larger role in our communities than simply allowing for movement of people and goods from place to place. In addition to its ability to add to and detract from our neighborhood quality of life as an integral part of our built environment, I have initiated an investigation to determine if transportation infrastructure can provide potential deterrents for criminal activity.

Hypothesizing that transportation infrastructure investments can help in controlling crime, this study further suggests that available public resources now slated for transportation improvements may yield greater benefits for communities through improved planning and design. This study had two primary objectives. The first objective was to determine whether transportation infrastructure has an effect on criminal behavior in communities irrespective of other factors that influence crime and delinquency. The second objective was to explore whether transportation infrastructure projects have the potential to intervene and deter crime. The work undertaken involved the use of quantitative and qualitative data analysis to explore and evaluate potential impacts. The study results provide community decision-makers with additional information for making informed decisions regarding community investments.

Research Questions

Given the potential that transportation infrastructure has in affecting community quality of life, and the understanding that crime is largely an opportunistic event, I

formed the following research questions around the notion that a relationship may exist between these two dynamics:

1. Does transportation infrastructure have an effect on criminal behavior within communities?
2. If so, does this effect differ between serious crimes (I) and non-serious crimes and misdemeanors (II)?
3. Can transportation infrastructure serve as a viable social intervention to deter criminal behavior within communities while simultaneously addressing transportation needs and quality of life issues?
4. Can criminal opportunities or "hot spots" be limited or removed through improved designs for transportation infrastructure?
5. Do transportation infrastructure improvements improve a community's sense of security or guardianship, which can have an indirect relationship on crime?

Summary of Findings

This section discusses the findings for the hypotheses that guided this research. This research focused on two primary hypotheses and two additional secondary hypotheses. Hypotheses 1 and 2 are discussed first, then hypotheses 3 and 4 are discussed afterwards.

Statewide Quantitative Analysis Findings

Hypotheses 1 and 2 relate specifically to the statewide quantitative analysis measuring the effects of transportation infrastructure on criminal behavior among

Pennsylvania boroughs. This analysis included 557 boroughs and looked at the effects of transportation infrastructure on two levels of crime as noted in the following hypotheses:

- Hypothesis 1: Controlling for specific demographic characteristics (e.g., population, median income, etc.), communities with higher transportation infrastructure improvement activity will experience reductions in reported Part 1 crimes compared to communities that have lower levels of transportation infrastructure improvement activity.
- Hypothesis 2: Controlling for specific demographic characteristics (e.g., population, median income, etc.), communities with higher transportation infrastructure improvement activity will experience reductions in reported Part 2 crimes compared to communities that have lower levels of transportation infrastructure improvement activity.

These hypotheses are very similar, differing only in the severity level of the types of crime that are measured. Hypothesis 1 predicts the effects of transportation infrastructure (project density) on serious crimes (Crime I) while hypothesis 2 predicts the effects of transportation infrastructure (project density) on less serious/minor crimes and misdemeanors (Crime II). I treated them separately, anticipating that the effects may differ based on the types of crime. The results of the analysis in Chapter IV indicate that project density, which is a measure of transportation infrastructure project activity among the boroughs, is significant across both dependent variables, crime I and crime II. In both cases, the relationship is positive meaning that irrespective of the control variables, as project density increases, crime I and crime II increase as well. Based on these results, I was able to reject both null hypotheses that no relationship exists.

The effect that transportation infrastructure (project density) has on criminal behavior (Crime I and Crime II) was significant, but also minimal. More surprising was the direction of the relationship. The results show a slightly *positive* relationship, suggesting that the more transportation infrastructure projects in a community, the more crime. This outcome is opposite of what I anticipated. Based on the theoretical perspectives used to formulate this research, I anticipated improvements in transportation infrastructure would reduce crime by adding a perception of guardianship (broken windows theory), building community pride and unity (collective efficacy), and increasing the potential for being caught because of increased lighting, more pedestrians, slower traffic, etc. (rational choice theory).

Despite the modest strength and opposite direction of the relationship, the significance of the relationship remains important. The projects included in this study were not specifically designed to reduce criminal behavior. Nonetheless, it appears that transportation projects have an effect on crime; but as typically engineered to improve movement and access they make it easier for crime to take place.

In many stories about crime, both fictional and non-fictional, the criminals rely on transportation to flee the scene of the crime. The more effective the transportation, the more likely they are to get in and get out. The Data-Driven Approaches to Crime and Traffic Safety (DDACTS) initiative discussed in Chapter II is based on this very notion. In this law enforcement operational model, location-based crime and traffic data help target "hot spots" for crime, crashes, and traffic violations (National Highway Traffic Safety Administration). DDACTS uses the knowledge that crimes often involve the use of motor vehicles to analyze crash and traffic violation activity and their relationship to

street crimes (National Highway Traffic Safety Administration, 2009). Therefore, it makes sense that transportation infrastructure improvements make transportation more effective for all users, criminals included.

Transportation infrastructure has been designed to improve walking, business, speed, gridlock, tourism, and economic development. Based on my research, it is not designed specifically to reduce crime, yet. Since we now know that a relationship between transportation infrastructure and crime exists, it may be possible to engineer toward crime reduction. Traffic calming transportation designs did not initially conform to early engineering and roadway design objectives that were aimed at increasing speed, capacity, and mobility (United States Department of Transportation, Federal Highway Administration [USDOT/FHWA], 1974). However, context-sensitive design initiatives in the early 2000's added physical and human environmental needs as additional priorities (American Association of State Highway and Transportation Officials (AASHTO), 2001). With that, the engineering community set out to accomplish traffic calming capabilities that established design speeds based on expected driver behavior. The success of this new thinking among transportation engineers suggests that engineering to reduce crime may also prove possible.

Case Study Findings

In addition to the primary hypotheses noted above, a series of secondary hypotheses were explored as part of this study. The following hypotheses relate to the effect that improved transportation infrastructure has on a community's sense of security and guardianship:

- Hypothesis 3: Improvements in transportation infrastructure have a positive effect on how individuals feel about security in their community.
- Hypothesis 4: Improvements in transportation infrastructure have a positive effect on how individuals feel about guardianship in their community.

These hypotheses follow the concept that improvements in the built environment will serve as a source of pride in the community. Through this increased pride, community members would be more inclined to unite and guard against vandalism and criminal activity similar to formal community watch programs (collective efficacy). However, the case study findings indicate that there was no change regarding sense of security and guardianship in response to the transportation infrastructure project in the Borough of Penbrook. In both cases, the majority of respondents felt good about their community regardless of the improvements that were made. Based on these results, the study would suggest that no relationship exists and I should accept the null hypotheses. However, the results from this case study represent just one project in just one community. The impact that this one project had is difficult to assess thoroughly and it is certainly not generalizable to a larger population of all communities. It seems quite plausible that in higher crime areas improvements due to new infrastructure would invoke community pride responses. Furthermore, the case study transportation infrastructure project was designed to alter traffic patterns and add traffic calming devices to slow traffic in key areas. While these changes were successful in rerouting non-resident commuter traffic, it did not add aesthetic improvements that would be cause for increased community pride. For this particular case study, the improvements primarily served a transportation only functionality.

In addition to the type of project, the proximity to the actual construction may also have played a role in the outcome. The respondents represented individuals from parts of the borough with varied exposure to the project. Their perspectives regarding the effects of this project on criminal behavior were dependent on their proximity to the area where the project took place. Those respondents who worked nearest the project clearly noticed changes in criminal activity while those who worked farther away were not impacted and therefore reported no significant changes. Because the project was intended to redirect transient and "cut- through" vehicle traffic on borough residential streets (Buchart Horn, Inc., 2007), those who experienced the physical changes within the community also experienced the impacts of these changes. Others farther from the project did not feel the same. In contrast, sense of security and guardianship for the majority of respondents were not dependent on their proximity to the project. Given the social context of this study, this effect may be diluted by other factors that challenge our ability to estimate the effects of social interventions (Judd & Kenny, 1981). Nonetheless, the case study results indicate that transportation infrastructure does have an effect on criminal behavior.

Limitations and Delimitations of the Study

Upon completion of this study, several limitations and delimitations remained. As noted in Chapter 1, the secondary data collected from local and/or regional enforcement agencies and the DOT are assumed to be the most accurate, complete, and current data available. Although many crimes go unreported and unknown, the data collected and maintained by local and/or regional enforcement agencies and the DOT provides the best available and reliable data. However, in the analysis phase it became

apparent that these data presented a major limitation in that many values were missing and it was necessary to impute them in order to increase the number of observations available for the analysis. The data spanned a six-year period and the completeness of the data improved in the later years. The imputation process boosted the number of observations by approximately 20%, which actually improved the analyses.

A second limitation reflects the element of time. This study was conducted over a six-year period and is, therefore, dependent on the conditions (e.g. economic) that took place during that period, which may have affected the degrees of criminal behavior. Although I was unable to account for all possible spurious influences, the final regression model used in the analysis controlled for six factors that could lead to potential variations. The temporal order of the data did not allow for pre-post potential in the analysis. This is because crime and transportation project activity are contiguous, beginning well before the study period and continuing after. Therefore, I was not able account for ongoing transportation infrastructure project activity that began prior to the start of the study period. This earlier project activity may have influenced the measures of crime taken at the start of the study period window.

Finally, the qualitative data gathered through the interviews as part of the case study are presumed to reflect honest and valid perceptions of the persons interviewed. Views expressed by the respondents do not necessarily reflect factual outcomes but are only perceptions of their reality, regardless of where they worked in the community. Although all of the individuals interviewed were familiar with the transportation infrastructure project, only a few had a day-to-day familiarity with the specific area where the construction project took place. This subset of the interview group was aware

of local activity and therefore could better respond to the questions in relation to the project. The perceptions of the other respondents, which were more distant to the construction, were likely shaped by experiences outside of the influential scope of the project. A more deliberative approach to selecting interviewees may have reduced the effects of this limitation.

Several delimitations also require discussion. One delimitation of this study is the post-only cross-sectional approach I used to identify transportation infrastructure projects in the statewide analysis. The transportation project data used for the statewide analysis provided limited information about the projects themselves. It included municipality name, project costs, start date, completion date, and a short description. As noted in Chapter 1, this information was useful in determining the size of the projects for inclusion within the scope of the study. Larger projects were factored into project density scores while minor projects were ignored. Without more detail on the type of project and where it was located, I was not able to assess the effect that proximity or project elements may have on criminal behavior. For this study I was able to determine a gross measure of the relationship between crime and transportation infrastructure, however, it may not be a sensitive enough measure to precisely detect effects.

Despite these weaknesses, the cross-sectional approach enabled me to distinguish between boroughs that had high levels of transportation infrastructure project activity, those that had moderate levels, and those that had no activity at all during the study period. Using this cross-sectional approach also provided a broader, more comprehensive population for my analysis that balanced regional influences and provided results that were more generalizable to the target population of Pennsylvania

municipalities. Future research will prove necessary to more accurately assess the specific effects of proximity and transportation project elements on criminal behavior.

Another delimitation of the statewide analysis is the spuriousness of the crime data and the possible influential factors. In particular, the nature of police practices varies widely from community to community. Some communities have dedicated resources, effective training, and good police management while others do not. As a result, the level and type of police activity has a direct effect on crime. Another factor that may have a spuriousness effect is the variation in types of crime potentially affected by transportation infrastructure projects. Some crimes may not be affected at all while others may be greatly influenced, yet I did not have the data necessary to investigate this concern.

The case study analysis presents a few specific delimitations. While focusing on a single borough as a case study for gathering qualitative data via one-on-one interviews offers a more in-depth understanding of the complex issues of crime and transportation infrastructure in communities, the detailed contextual analysis of this single case cannot be generalized to a larger population. To account for this, I used a mixed methods approach that added the results of the qualitative research to supplement and strengthen the previous statewide quantitative research. This approach avoids the risk that a single, stand-alone case study may lack relevance while adding deeper insight to a largely quantitative study. This triangulation of data through converging evidence helped to strengthen my research and corroborate the findings.

A final delimitation of the case study is lapse in time that occurred between the project completion and the actual interviews. While a time lapse was essential to allow

for observation of the potential changes in crime patterns, two to three years would have been ideal. For many of the respondents, their perceptions may have changed over the seven years that passed since the project was completed. It was evident that the crime data reported for Penbrook showed a decline in the years immediately following the project, but these levels began to rise as the project got older. When I conducted the interviews, new experiences relative to criminal activity may have replaced initial perceptions resulting from the transportation infrastructure improvements. Despite this limitation, the reported perceptions of these individuals regarding changes in criminal behavior, along with their sense of security and guardianship in their community, did contribute to my understanding of the impact that this transportation infrastructure project had on their community. Transportation infrastructure is, in fact, one of several key factors that influence crime and delinquency in communities.

Policy Implications and Recommendations for Future Studies

Implications for Policy and Practice

Pennsylvania communities face an unending demand for funds. The maintenance and improvement of transportation infrastructure and the monitoring and control of criminal behavior coexist among these competing demands. Costs associated with both generate concern for policy makers and other community leaders. Many disciplines have investigated the causes and origins of crime in an effort to reduce its effects on communities. The U.S. Department of Justice, Federal Bureau of Investigation (FBI) reports several known factors that affect the volume and type of crime occurring from place to place. These factors are (U.S. Department of Justice, Federal Bureau of Investigation, 2010):

- Population density and degree of urbanization.
- Variations in composition of the population, particularly youth concentration.
- Stability of the population with respect to residents' mobility, commuting patterns, and transient factors.
- Modes of transportation and highway system.
- Economic conditions, including median income, poverty level, and job availability.
- Cultural factors and educational, recreational, and religious characteristics.
- Family conditions with respect to divorce and family cohesiveness.
- Climate.
- Effective strength of law enforcement agencies.
- Administrative and investigative emphases of law enforcement.
- Policies of other components of the criminal justice system (i.e., prosecutorial, judicial, correctional, and probational).
- Citizens' attitudes toward crime.
- Crime reporting practices of the citizenry.

This study included several of these factors in the analysis, most notably, transportation. While this collaborative effort suggests that research has already connected these two policy areas, existing literature fails to make a connection between investment in transportation infrastructure and reductions in criminal behavior. From as early as the 1960's (Jacobs, 1961), the potential relationship between transportation infrastructure and community has been recognized. New Urbanism and Smart Growth initiatives have reaffirmed the influence that streets have on our communities and more

contemporary studies on regional planning (Behan, Maoh, & Kanaroglou, 2008; Duany & Speck, 2010; Katz, 1994). However, this literature focuses more on reducing dependence on automobiles, reducing congestion, and eliminating sprawl by encouraging pedestrian- and bike-friendly communities with easy access to public transportation than on reducing crime.

Some recent studies do link transportation and crime prevention. However, these initiatives have really only explored transportation modes as a means for facilitating or policing against criminal behavior, not the use of transportation design as a deterrent (Petty, 2006). In fact, in the same way that it can facilitate policing efforts, transportation can provide easy egress for offenders fleeing a crime scene. Recognizing this relationship, government officials have determined a number of relational factors between crime and motor vehicles through the United States Department of Transportation's (DOT's) initiative on Data-Driven Approaches to Crime and Traffic Safety (DDACTS) (National Highway Traffic Safety Administration, 2013).

The findings from my research support that a significant relationship between criminal activity and transportation infrastructure exists. While this relationship was not in the direction anticipated, very few of the projects involved were specifically engineered to reduce crime. Each of these projects was based on a set of priorities for the funding that ranged from reducing congestion to rehabilitating or upgrading existing infrastructure. Unknowingly, however, these initiatives also had an effect on criminal behavior.

One example of this was observed in West Palm Beach, FL. Clematis Street was one of the 25 street transformations showcased in "Rethinking Streets: An Evidence-

Based Guide to 25 Complete Street Transformations" (Schlossberg, Rowell, Amos, & Sanford, 2013)." They note that downtown West Palm Beach, like other cities, had evolved into a community only for commuters. As part of a street transformation, this community reduced the street lanes from three lanes to two; converted redirected traffic flow; widened sidewalks; and added landscaping, trees and street furniture to improve the pedestrian areas. Prior to these revitalization efforts, Clematis Street was known for illegal activities like drug dealing and prostitution. Yet, following this street transformation, drug dealing and prostitution disappeared. It was not long before this improved pedestrian atmosphere attracted shoppers, families, tourists and weekly block parties, which made Clematis Street a desirable public space (Schlossberg, Rowell, Amos, & Sanford, 2013, p. 80).

Recognizing the effect that transportation infrastructure can have on crime reduction, policy makers should rethink policies for establishing priorities on spending. New policies should ensure that, to the extent possible, transportation infrastructure projects should be engineered to consider the effects on criminal behavior. With this in mind, community leaders facing conflicting and competing demands for services, can make more-informed decisions on the use of limited resources. Every dollar invested can yield multiple benefits in the long run.

Recommendations for Future Studies

This study confirms that a relationship between transportation infrastructure and criminal behavior exists, but it does not provide further insight regarding this relationship. For example, this study did not identify the specific types of infrastructure that may have more influence than others. Additionally, while this study does break

down criminal behavior into Crime I and Crime II, it does not assess criminal behavior more succinctly by the specific types of crime or types of criminals that commit crime.

However, recognizing that this relationship is significant sets forth a critical first step in evaluating the full potential of transportation's role to enhance the quality of life and reduce crime and the fear of crime in our communities. Future research should further explore this relationship to understand its effects more specifically. The first step in future research may be to conduct a secondary analysis of this research to move beyond the conclusion that there is an effect toward establishing an explicit causal chain (Judd & Kenny, 1981). Additional research may then seek to isolate the different types of infrastructure projects (lighting, traffic calming devices, walkways, parking, traffic design, etc.) and assess which ones might be engineered to have the greatest effect on reducing crime. Future research could also examine the specific types of crime and the types of criminals that engineered modifications in transportation infrastructure projects may deter most effectively. Research in this area could explore the role of transportation infrastructure relative to guardianship as supported in both "Broken Windows" and "Rational Choice" theories. As part of this research, cost comparisons between investments in transportation infrastructure and investments intended solely for the purpose of reducing crimes would add further information regarding the value of one approach over the other.

Other recommendations for research include comparing these results with larger cities, which have much more complex issues related to crime and transportation than boroughs, and with townships, which lack a central hub and where transportation infrastructure has the greatest potential to make a difference. Looking at crime trends,

future research should explore shifts in criminal activity displaced by project activity, as well as duration of the impact of the deterrence effects produced by transportation infrastructure projects.

In addition to future research to further explore the relationship between crime and transportation infrastructure, research on the nature in crimes within boroughs may be of interest based on the findings of this study. For example, in the statewide analysis, the percent of poverty in a borough predicted Part II crimes but not Part I crimes. This suggests that poverty may have a greater impact on impulsive crimes over more serious crimes. Another study of interest could explore youth population and criminal behavior measured at the borough level since youth population as a control variable in this study showed a significant relationship with both Crime I and Crime II.

Conclusion

The answers provided by future research could further inform community leaders and improve the planning and design of public spaces. When we begin to look at the assets in our communities as more than simply their intended purposes, we can change the way that we plan for their use in the end.

"If you change the way you look at things, the things you look at change."

- Dr. Wayne Dyer (Dyer, 2016)

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Appendix A

Interview Instrument

INTERVIEW GUIDE AND QUESTIONS AND TOPIC MAP

Overview:

The purpose of this study is to evaluate the impact of a recent transportation related project in the target community. Participation in this study will require approximately 30 minutes per interviewee for a one-on-one interview with the researcher. First, each interviewee will be asked to briefly describe their position. Next, the researcher will ask a series of structured and open-ended questions, Responses to these questions will be collected using a laptop computer. Finally, interviewees will be asked to review the record of their responses to ensure they reflect the thoughts discussed during the interview prior to concluding.

The interview design focuses on three main components: 1) researcher relationship with those who were studied, 2) site and participant selection, and 3) data collection. While site and participant selection, and data collection are critical elements in the interview process, relationships with those who are studied are equally important. These "gatekeepers" can either facilitate or obstruct the study depending on their perception of the researcher, the situation, the purpose of the study, and so on.

Participant and site selection - For Police, Emergency Response, and Public Works Departments, the researcher will contact the current manager and asked for a list of the employees who have worked for the agency since 2004 (pre-project). From this list, the researcher will obtain permission to contact these employees and conduct a one-on-one interview regarding their perceptions about the community over the past decade. Interviews with those who agree to participate will be conducted in an on-site during regular business hours to facilitate access and minimize inconvenience. For business owners, the researcher used a list of businesses located in the Borough of Penbrook obtained from the Dauphin County Tax Office. Next, the researcher will contact each business to ask if they had been the owner in business since 2004. If their response if affirmative, the researcher will request an interview. Interviews with business owners/managers will be conducted at their place of business to facilitate access and minimize inconvenience.

Interview process - Interviews will be conducted one-on-one in a private meeting room or location. In most cases, data from the interviews will be collected using a laptop computer with a spreadsheet that was prepopulated with questions and includes room for

responses. Space for additional comments is also included to allow the researcher to ask additional questions and record responses. In some cases, the setting will not allow for use of a laptop computer. In those cases, the researcher will capture responses manually and incorporate them with the others prior to analysis.

Interview Introduction:

Hi. My name is Sherri Zimmerman. I am a doctoral candidate at Indiana University of Pennsylvania in the Administration & Leadership Studies Program. I am working on my dissertation on the influence of transportation infrastructure on crime in communities. The purpose of this study is to evaluate the impact of a recent transportation related project in your community.

I appreciate your willingness to participate in this interview. Participation in this study will require approximately 30 minutes of your time for a one-on-one interview with the researcher. Is this a good time for this interview?

First, I would like you to briefly describe your position. Next, I will ask you a series of structured and open-ended questions. I will capture your responses using my laptop computer. Upon completion of the interview, I will give you a chance to review this record of your responses to ensure they reflect your thoughts prior to concluding the interview.

Interview Questions

Community Perspective:

1) Please give me your name, title, and organization (1a)
2) Briefly describe your position in this organization (1a)
3) What recent changes are you aware of in this community? Are you aware of the recent transportation project? If so, what are some of the features you recall that were a of that project? (1b)

    PROBE: Project overview

Incidents of Criminal Activity:

4) Are you aware of any criminal activity in this community? (2)
5) What types of crime in this community do you hear about most? (2a)

6) How would you rate the average level of severity? (2a-1)

○	○	○	○	○	○
Nuisance Crimes	Minor crime	Moderate crime	Somewhat serious crime	Serious Crime	Very serious crime

PROBES: What does "severity" mean to you?

Do you understand all of the responses available?

Do the selections include your "best answer"?

7) Is your sense of severity different after the project was completed? (2a-1)

PROBES: How so?

Do you feel these changes are for the better?

What factors do you believe caused this change?

8) What is your perception about the types of offenders that are most common in this community? (2a-2)

PROBES: Youth, juvenile delinquents

Homeless or poor in need

Drug influenced

Non-residents/transients

9) Has this perception changed since the project was completed? (2a-3)

PROBES: How so?

Do you feel these changes are for the better?

What factors do you believe caused this change?

10) Does this community have criminal "hot spots"? If so where do you feel they are located? (2b)

PROBES: How do you define “hot spots”?

What do “education achievements” mean to you?

Is your answer influenced by perceptions of others?

11) Has the location of these “hot spots” changed since the completion of the project? (2b-1)

PROBES: How so?

Do you feel these changes are for the better?

What factors do you believe caused this change?

12) What is your perception regarding the frequency of offenses in this community?

(2c-1)

○	○	○	○	○	○
Rare	A few offenses from time to time	Weekly offences	Daily offenses	More than 1-2 every day	Always something going on

PROBES: What is this perception based on?

Do you feel this perception is common in this community?

Is your answer influenced by perceptions of others?

13) Do you feel there are patterns regarding the times when crime occurs? (2c-2)

PROBES: Day versus night?

Weekends versus weekdays?

14) Do you feel the time patterns of criminal activity have changed since the project was completed? If so, how? (2c-3)

PROBES: More or less frequent?

Patterns for when it occurs shifted?

What factors do you believe caused this change?

Sense of Security:

15) Based on the changes we have discussed, how do you feel about your personal safety? (3a)

PROBES: When you are at home? (3a-1)

When you are in public places in the community? (3a-2)

16) Has this feeling about personal security changed since the project was completed? (3a-3)

PROBES: What factors do you believe caused this change?

Is this feeling common among others in the community?

17) Do you feel that property is safe in this community? (3b-2)

PROBES: Personal/business property?

Property in the community?

18) Has this feeling about the security of property changed since the project was completed? (3b-3)

PROBES: What factors do you believe caused this change?

Is this feeling common among others in the community?

19) How do you feel about the safety of visitors in this community? (3c)

PROBES: Afraid or skeptical of them?

Afraid for them?

Guardianship:

20) How do you feel about your community? (4a-1)

○	○	○	○	○	○
Hate it	Don't care, not staying long	Embarrassed	Ambivalent	Proud	Very proud

PROBES: Explain your answer.

Is this a common feeling in this community? (4a-2)

Do you encourage visitors or outsiders? (4a-3)

21) Has this feeling changed since the project was completed? (4a-4)

PROBES: How?

Is this a common feeling in this community?

What factors do you feel caused this change?

22) Do you feel a sense of community guardianship in this community? (4b)

PROBES: How do you define guardianship?

23) Would you willingly protect yourself or property if needed? Others? (4b-1)

PROBES: To what extent?

Have you ever had to?

Has this willingness changed since the project was completed?

24) Would you willingly protect community property if needed? (4b-2)

PROBES: To what extent?

Have you ever had to?

Has this willingness changed since the project was completed?

25) Is this sense of "willingness to protect' common in this community? (4b-3)

PROBES: How? What are some examples?

Is this a common feeling in this community?

What factors do you feel caused this change?

26) Has this feeling changed since the project was completed? (4b-4)

PROBES: How?

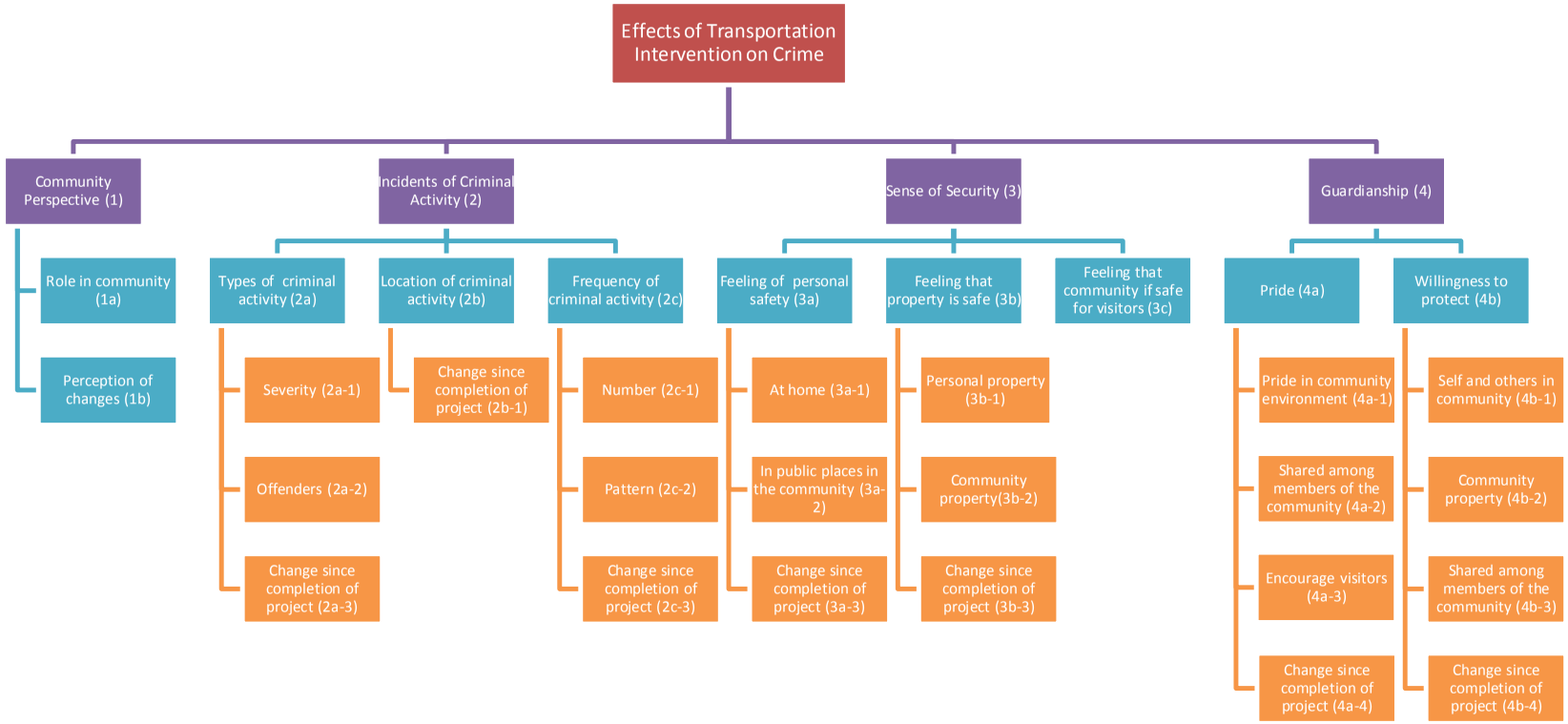
What factors do you feel caused this change?

Conclusion:

That concludes the questions I have prepared for this interview. Do you have anything else you would like to add before I conclude? Please take the time to review your responses briefly to ensure I have accurately captured your thoughts.

Thank you for your time!

Topic Map:
Transportation Infrastructure & Crime



Appendix B

List of the Measures to Reduce Ethical Risk

1. Informed the participants that they were free to decide not to participate in this study or to withdraw at any time without adversely affecting the relationship with the researcher or IUP.

2. Informed the participants that their decision would not result in any loss of benefits to which they might otherwise be entitled.

3. Assured the participants that they could withdraw at any time by notifying the researcher in advance of or during the interview.

4. Assured the participants that, upon their request to withdraw, all information pertaining to them would be destroyed.

5. Assured the participants that all information would be retained in the strictest confidence and would have no bearing on their standing in the community.

6. Assured the participants that their responses would be considered only in combination with those from other participants.

7. Notified the participants that the information obtained in the study may ultimately be published in scientific journals or presented at scientific meetings and that in such an event, their identity would remain strictly confidential.

8. Provided assurance of these measures to participants and obtained their consent to proceed. Appendix C contains the informed consent form used for this study.

9. Obtained Indiana University of Pennsylvania Institutional Review Board (IRB) approval prior to initiation of the study. Appendix D contains the IRB approval letter as well as the approval to conduct the study as authorized the School of Graduate Studies and Research.

Appendix C

Informed Consent Form

You are invited to participate in this research study. The following information is provided in order to help you make an informed decision whether or not to participate. If you have any questions please do not hesitate to ask. You are eligible to participate because you are a police officer, municipal employee, emergency responder, or business owner/operator in the Borough of Penbrook and have served in this capacity since 2005.

The purpose of this study is to evaluate the impact of a recent transportation related project in your community. Participation in this study will require approximately 30 minutes of your time for a one-on-one interview with the researcher. First, you will briefly describe your position. Next, you will be asked a series of structured and open-ended questions and your responses will be collected using a laptop computer. Finally, you will review the record of your responses to ensure they reflect your thoughts prior to concluding the interview.

Your participation in this study is voluntary. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the researcher or your employer. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, you may withdraw at any time by notifying the researcher who will be administering the test. Upon your request to withdraw, all information pertaining to you will be destroyed. If you choose to participate, all information will be held in strict confidence and will have no bearing on your standing with the University or in the community. Your response will be considered only in combination with those from other participants. The information obtained in the study may be published in scientific journals or presented at scientific meetings but your identity will be strictly confidential.

If you are willing to participate in this study, please sign the statement below and deposit in the designated box by the door. Take the extra unsigned copy with you. If you choose not to participate, deposit the unsigned copies in the designated box by the door.

RESEARCHER:
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This project has been approved by the Indiana University of Pennsylvania Institutional Review Board for the Protection of Human Subjects (Phone: 724/357-7730).

VOLUNTARY CONSENT FORM

I have read and understand the information on the form and I consent to volunteer to be a subject in this study. I understand that my responses are considered confidential and that I have the right to withdraw at any time. I have received an unsigned copy of this informed Consent form to keep in my possession.

Name (PLEASE PRINT) _____

Signature _____

Date _____

Phone number or location where you can be reached _____

Best days and times to reach you _____

I certify that I have explained to the above individual the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, have answered any questions that have been raised, and have witnessed the above signature.

_____ _____

Date Researcher's Signature