Homicide Patterns in Urban Places: A Geospatial Analysis of Homicide in Baltimore, M.D.

Kayla Toohy
University of Central Florida

Part of the Criminology Commons
Find similar works at: https://stars.library.ucf.edu/etd2020

This Doctoral Dissertation (Open Access) is brought to you for free and open access by STARS. It has been accepted for inclusion in Electronic Theses and Dissertations, 2020- by an authorized administrator of STARS. For more information, please contact STARS@ucf.edu.

STARS Citation
https://stars.library.ucf.edu/etd2020/1301
HOMICIDE PATTERNS IN URBAN PLACES:
A GEOSPATIAL ANALYSIS OF HOMICIDE IN BALTIMORE, MD

by

KAYLA RACHEL TOOHY
M.A. University of Memphis, 2018
B.A. University of Memphis, 2016

A dissertation submitted in partial fulfillment of the requirements
for the degree of Doctor of Philosophy
in the Department of Sociology
in the College of Sciences
at the University of Central Florida
Orlando, Florida

Summer Term
2022

Major Professor: Jay Corzine
Extant criminological research examining research questions oriented on understanding the spatial distribution of violent crime instances, such as homicide, have often employed the theoretical foundations of both social disorganization theory and routine activities theory. Though there is much research using these theories independently and in conjunction with one another, few studies have integrated the theories in analyses of homicide at multiple levels of aggregation. The current study is conducted to analyze homicide incidents in Baltimore, Maryland from 2014 through 2018. The analysis conducted considers both social disorganization and routine activities theory variables to test the explanatory power of each theory regarding homicide at both the census tract and block group levels of analysis. ArcGIS Pro 2.9.2 is used to display the results in a visual manner. Negative binomial regression analyses are conducted to examine the impact of theoretical variables of interest on homicide count within the metropolitan area of Baltimore city. The results of this study have further implications regarding our understanding of the theoretical applications of both social disorganization and routine activities theories in understanding the spatial distribution of instances of major violent crimes, specifically regarding homicide.

Key words: social disorganization theory, routine activities theory, homicide, Baltimore, GIS
I would like to dedicate this work to my family. Without their love and support, I would not be where I am today, and this dissertation would not have become a reality.

To my mother, Loretta Toohy, you showed me how to be a strong and independent woman who could face and overcome any obstacle placed in her pathway. Thank you for every good morning call and always being there to answer at any time of the day when I needed an ear. I will always be thankful that life chose you to be my mother.

To my father, Kevin Toohy, you taught me to approach every situation with kindness and a calm demeanor, to understand that the meaning of life is learning how to gracefully recover from any deviation placed in your path, and to persevere when the road looked dark and dim. I will always treasure our adventures together and remember the life lessons you have taught me.

To my twin brother, Sean Toohy, you taught me to stand tall and confidently face challenges with a smile and a laugh, remember to find time for enjoyment in life, and treasure the moments we share with our loved ones as they become fewer and further between. I’m so grateful we get to share our lives’ journey together.

~

In addition, I would like to dedicate this work to my friends. The years spent in this Ph.D. program would have been lonely indeed without the encouragement and time spent with my chosen family.

To Karli Province, my partner in crime, I truly do not know what I would do without you. You are the sister I never had and the best friend I could ever ask for. I will forever look forward to
conferences together, traveling the world with each other, and watching our friendship continue
to evolve throughout the years as we grow old.

To Elise Lorenzo, my time in Orlando would not have been anywhere as amazing without your
friendship. I will treasure our trips together, the moments we have spent working together at
Citizen Science GIS, and all the projects we have tackled as a team both in our personal and
professional lives. I am beyond thankful to have met you.

To Christopher Scott-McKay, thank you for always being there to support me when I doubted
myself and my journey in this program. Your friendship has been a genuine light through
difficult moments, and I will always treasure our time together and the memories we have
created with one another.

~

Finally, I would like to dedicate this work to myself. There were many times throughout the last
four years that I lost sight of my “why”. Through physical battles and emotional battles, self-
doubt, and sacrifice, I have made it to the end of this chapter. Obtaining this degree and finishing
my dissertation are achievements that I am indescribably proud of. I learned more about myself
in the last four years than in the entirety of my life before I began at UCF. I will live the rest of
my life grateful for this journey, with a passion to continue exploring the world around me.
ACKNOWLEDGMENTS

This research would not have been possible without the guidance, support, and mentorship of a great many people. First, I must begin with my sincere gratitude for Jay Corzine, my dissertation chair. I met Dr. Corzine as a graduate student at the University of Memphis while attending one of my first academic conferences. While I considered pursuing my Ph.D. following graduation, Dr. Corzine called me, and we had a long phone call about the demands and rigors of a Ph.D. program. After our call, I felt confident that with a mentor who championed for his students like Jay, I would be successful in finishing the program.

I must also recognize Dr. Lin Huff-Corzine for her continual support throughout my time at UCF. Lin created a home for her students where we could go when we felt lost or homesick. I will never forget the first year of this program and all the moments we spent together in her office often discussing our research, or quietly reflecting over events that had occurred, together. Without Dr. Huff-Corzine, my academic mother, co-author, and mentor, I would have felt that much more lost as I navigated the program and life outside of graduate school.

In addition, I would like to acknowledge the rest of my dissertation committee. To Dr. James McCutcheon, thank you for agreeing to stick with me throughout the rest of my graduate school journey. As my thesis chair at The University of Memphis, you introduced me to a love of geospatial criminological research that has grown into a passion I will pursue throughout the rest of my career. Your mentorship and guidance have been a constant throughout the last six years, and I am so thankful for your continued support. To Dr. Amy Reckdenwald, thank you for your willingness to always provide feedback whether it was this dissertation project, or in other areas.
of research we have conducted together. Without you, I would have given up on publishing my first, first-authored piece. Your mentorship has been invaluable. To Dr. Yingru Li, thank you for the time you have spent with me to aid in the development of my methodological GIS skillset. I have learned so much from you in the past few years and appreciate the guidance you have provided in our research endeavors.

I would also like to acknowledge Dr. Timothy Hawthorne for his limitless energy and willingness to support students. I am so grateful for my time with Citizen Science GIS and the new academic passions I have discovered during my time as a graduate research associate with the organization. The opportunities you provide to undergraduate and graduate students are truly life-changing and my work with this organization has been a huge part of the motivation I have had to finish my Ph.D. journey.

Finally, I would like to acknowledge the entire sociology department of UCF including the amazing faculty that have supported the students as we have navigated our programs, the incredible staff that have been there to answer any questions we may have, and the students and members of my cohort who I have had the privilege to learn and grow with during my time here. It has been a challenging last few years and without my sociology community at UCF it would have been that much harder.
# TABLE OF CONTENTS

LIST OF FIGURES .............................................................................................................................. x
LIST OF TABLES ................................................................................................................................. xi

CHAPTER ONE: STATEMENT OF THE PROBLEM .................................................................................. 1
  1.1 Introduction ...................................................................................................................................... 1

CHAPTER TWO: CRIME AND OUR ENVIRONMENT .............................................................................. 7
  2.1 The Evolution of Environmental Criminology ............................................................................. 7
      2.1.1 Macro-analytic roots .............................................................................................................. 10
      2.1.2 Meso-analytic roots ........................................................................................................... 13
      2.1.3 Micro-analytic roots ............................................................................................................ 23

CHAPTER THREE: HOMICIDE IN URBAN PLACES ............................................................................ 33
  3.1 Urban Homicide ............................................................................................................................. 33
      3.1.1 Social Disorganization and Homicide .................................................................................. 34
      3.1.2 Routine Activities Theory and Homicide ......................................................................... 39
  3.2 Limitations of Prior Literature ...................................................................................................... 42
  3.3 The Current Study ......................................................................................................................... 46
  3.4 Contributions to Research and Policy ........................................................................................... 47

CHAPTER FOUR: DATA AND METHODOLOGY .................................................................................. 48
  4.1 Study Population & Data .............................................................................................................. 48
  4.2 Variables ........................................................................................................................................ 50
      4.2.1 Dependent Variable ............................................................................................................. 50
      4.2.2 Independent Variables (Social Disorganization Theory) .................................................... 51
      4.2.3 Independent Variables (Routine Activities Theory) ............................................................ 53
      4.2.4 Control Variable .................................................................................................................. 54
  4.3 Analytic Strategy ............................................................................................................................ 54

CHAPTER FIVE: RESULTS ................................................................................................................... 56
  5.1 Descriptive Statistics .................................................................................................................... 56
  5.2 Results for Negative Binomial Regression Analyses .................................................................... 63

CHAPTER SIX: DISCUSSION & CONCLUSION .................................................................................. 69
6.1 Discussion ......................................................................................................................... 69
6.2 Major Findings .................................................................................................................. 69
6.3 Limitations & Future Research ......................................................................................... 72
6.4 Conclusion ......................................................................................................................... 72
APPENDIX: IRB DECISION LETTER .................................................................................... 74
REFERENCES .......................................................................................................................... 77
LIST OF FIGURES

Figure 1: Homicide in Baltimore 2014-2018.......................................................... 4

Figure 2. Census Tracts Distribution of Homicide 2014-2018.............................. 56

Figure 3. Block Group Distribution of Homicide 2014-2018................................. 61
LIST OF TABLES

Table 1. Descriptive Statistics 2014-2018 Census Tract Homicides in Baltimore (N = 200)...... 57
Table 2. Social Disorganization Theory Correlation Matrix Census Tracks (N = 200).............. 58
Table 3. Routine Activities Theory Correlation Matrix Census Tracts (N = 200)..................... 59
Table 4. Descriptive Statistics 2014-2018 Block Group Homicides in Baltimore (N = 653)..... 60
Table 5. Social Disorganization Theory Correlation Matrix Block Groups (N = 653).......... 62
Table 6. Routine Activities Theory Correlation Matrix Block Groups (N = 653).................. 63
Table 7. Social Disorganization Theory Negative Binomial Regression Census Tract Homicide (N = 200)............................................................................................................. 64
Table 8. Routine Activities Theory Negative Binomial Regression Census Tract Homicide (N = 200).......................................................................................................................... 65
Table 9. Social Disorganization Theory & Routine Activities Theory Negative Binomial Regression Census Tract Homicide (N = 200)................................................................................................................ 66
Table 10. Social Disorganization Theory Negative Binomial Regression Block Group Homicide (N = 649)................................................................................................................................. 67
Table 11. Routine Activities Theory Negative Binomial Regression Block Group Homicide (N = 653)................................................................................................................................. 67
Table 12. Social Disorganization Theory & Routine Activities Theory Negative Binomial Regression Block Group Homicide (N = 649)................................................................................................................ 68
CHAPTER ONE: STATEMENT OF THE PROBLEM

1.1 Introduction

Homicide is a major public health concern in the United States. Homicide rates in the United States have been reported in the past as 6.9 times higher than other high-income countries (Richardson & Hemenway, 2011). Considerable social science research has been conducted to analyze and understand the spatial distribution of homicide and its relationship to demographic, economic and social variables (e.g., Burraston, Watts, McCutcheon, & Province, 2019; Burraston et al., 2018; Groff & McEwen, 2006; Kennedy & Forde, 1990; McCall, Land, & Parker, 2010; Sharkey, 2010; Smith & Sandoval, 2018; Tita & Griffiths, 2005). Much of this research has been conducted at the macro-level (Burraston, Watts, McCutcheon, & Province, 2019; Burraston et al., 2018; Krohn, 1976; Land et al., 1990; McCall, Land, & Parker, 2010; Messner, 1982; Pratt & Cullen, 2005) and another significant portion has focused on existent micro-level relationships (Groff & McEwen, 2006; Kennedy & Forde, 1990; Messner & Tardiff, 1985) between this type of violent crime and additional variables of interest. To date, very few studies have explored multi-level analyses of homicide to investigate the changes in relationship between homicide and demographic, economic and social factors in surrounding areas (e.g., Land, McCall, & Cohen, 1990; Sharkey, 2010; Smith & Sandoval, 2018).

One city within the United States that has had a consistently high number of homicide incidents is Baltimore, Maryland. Baltimore has reported high crime rates for many decades, including that of their annual homicide rate. Research has shown persistent differences in homicide rates between regions in Baltimore, which are especially evident when researchers employ crime mapping techniques (Man, Kai, & Mun, n.d.). A recent study conducted to better
understand the impact of homicide events for young Black men (18-24) in Baltimore, MD showed that on average, study participants experienced at least three homicide deaths of loved ones throughout their lives (Smith, 2015). Primarily these losses were that of other male peers and they occurred throughout various stages over the life course, showing to be an enduring threat to the overall well-being of young Black men in Baltimore. In another study conducted by Smith and Patton (2016), posttraumatic stress was evaluated in the context of homicide incidents experienced by Black males within Baltimore City. These authors found that participants consistently reported pervasive violence as a characteristic of their neighborhood communities. One study participant provided context for a common response, “It’s Baltimore,” that had often followed a prompt for individuals to describe their neighborhoods stating, “Guns. Drugs. People getting locked up. People selling weed. People getting shot,” which reflects an implicit understanding of the violence that exists within this city (Smith & Patton, 2016, p.216). For the 37 study participants, 119 deaths were reported stemming from lethal acts of community violence. All 37 study participants stated that they had experienced at least one loved one’s homicide, with an average of three homicide deaths reported. The study findings showed that 30% of participants had reported that they witnessed their loved one’s murder.

Baltimore has suffered from high homicide rates throughout the last three decades. As a city of roughly 950,000 people in 1940, the population steadily declined over the next six decades leading to a reduction of about 300,000 residents by 2010 (Baltimore City Department of Planning, 2018). With roughly 620,961 residents in 2010, this population decline has impacted the economy of Baltimore City greatly through the loss of tax revenue as well as through the reduction of the labor force. As of July 1st, 2019, the City of Baltimore’s population
had further declined to roughly 593,490, the lowest total population of the city in more than a century (U.S. Census Bureau, 2019). Since the 2015 death of Freddie Gray and the ensuing civil unrest, the city has experienced annual declines in population culminating in the low number of residents reported by the Census in 2019 (The Baltimore Sun, 2020).

While this population decline has continued in the city, homicide incidents have reached the highest numbers the city has seen since the 1990s (The Baltimore Sun, 2017). In 1990, 305 homicide incidents were reported. With some fluctuation throughout the decade, homicide incidents remained over 300 annually until a decline in 2000. Documented incidents of homicide for 2000 included 261 individually reported incidents. In the following decade, homicide incidents peaked in 2007 with a reported 282 incidents and a low of 223 in 2010. A marked increase in homicide incidents occurred in 2015 with 342 incidents, a difference of +133 incidents following the 2014 numbers (211 reported homicides). Since 2015, homicides in Baltimore have remained over 300 annually.

Using the Baltimore Sun’s Baltimore Homicides map, researchers are able to visually observe the distribution of homicide incidents from each year between 2007-2021 (The Baltimore Sun, 2021). Specifically, regarding the homicide incidents that have occurred from 2015 to 2020, we are able to track not only the number of incidents, but the locations in which they occurred over the five-year period. In 2016, 318 incidents were mapped throughout the city, with 342 incidents mapped in 2017, 309 in 2018, 348 in 2019, and 335 in 2020. These reported homicide numbers represent a major violent crime problem that has been ongoing in the city over the last four decades.
Figure created using ArcGIS Pro 2.9.2. Homicide data collected from the Baltimore Open Data Portal ‘Part One Crimes’ file. Baltimore city boundary file downloaded from the U.S. Census Tiger shapefiles.

**Figure 1: Homicide in Baltimore 2014-2018.**

Programs have been put in place by various entities within the city to reduce violent crime incidents in historically violent neighborhoods within Baltimore City. One such evidence-based program, Safe Streets, modeled after Chicago’s CeaseFire program has reported success over the duration of its implementation. Specifically, Safe Streets has been associated with homicide reductions of 56% in Cherry Hill and 26% in McElderry Park. In Ellwood Park’s program, a reported reduction of 34% occurred in nonfatal shootings. Overall, the program proved to be associated with significant reductions in gun violence in three of the four
historically violent neighborhoods in Baltimore City under evaluation (Johns Hopkins Bloomberg School of Public Health, 2012). Another more recent program initiated in 2020, I Care Baltimore, has been designed to reduce violent crime by removing guns from the hands of criminals. Their approach is to highlight programs offering alternatives to violence and increase awareness of federal prosecution for violent repeat offenders to empower community members in the City of Baltimore (Watson, 2020).

The pervasive problem of lethal violence in the City of Baltimore makes it a prime location to conduct homicide research. The current project aims to incorporate quantitative analysis of homicide distribution and the relationship of this violent crime with demographic, economic and social variables at two levels of aggregation. Four primary hypotheses are tested in the current study of homicide in Baltimore, MD. First, it is hypothesized that block groups or census tracts with elevated levels of disadvantage and geographic mobility will have higher homicide counts. Second, it is hypothesized that block groups or census tracts with lower levels of racial and ethnic heterogeneity will have higher homicide counts. Third, it is hypothesized that higher scores on the attractive target index, higher numbers of motivated offenders, and a lower level of population density, used as a proxy for capable guardianship, will all contribute to higher counts of homicide within both census tracts and block groups. Finally, when combining both sets of variables in a single model, it is hypothesized that the combination of theoretical constructs will increase the explanatory power of the model demonstrating the importance of integrating theoretical perspectives in expanding our understanding of the geography of homicide.
Quantitative data is collected from a few different sources. Homicide incidents for the five-year period were accessed using the City of Baltimore’s open data portal. Information for demographic, economic and social variables of interest was collected using the United States Census’ American Community Survey (ACS) five-year estimates for 2018. Finally, United States Census TIGER/line shapefiles were used to create distribution maps of homicide incidents between 2014 and 2018 incorporating related additional variables of interest.

Chapter One outlines the extent of the homicide problem in Baltimore and provides compelling statistics to support the choice of using this city as a focal point for the project’s analysis. Chapter Two provides an outline of the development of the discipline of environmental criminology, often used as a foundation to conduct violent crime studies regarding the distribution of homicide. Chapter Three presents an overview of empirical homicide studies that have been conducted throughout the last few decades on various aspects of homicide in urban locations. Chapter Four outlines the data that is used within the current project and the methodology chosen for analysis of homicide and selected variables of interest. Chapter Five will present the results of the quantitative analysis conducted for the present study. Finally, Chapter Six provides a discussion of these results and the implications of the current research findings for future homicide studies.
CHAPTER TWO: CRIME AND OUR ENVIRONMENT

2.1 The Evolution of Environmental Criminology

Criminological studies of violent behavior have progressed through the development of theoretical orientations and the continual advancement and implementation of statistical and technological software. One such area of criminology that has been expanded and more fully explored as a result of this technological advancement is environmental criminology. Environmental criminology is a family of theories oriented on better understanding criminal patterns within built environments focused on the immediate circumstances of criminal events (Wortley & Townsley, 2016). Brantingham and Brantingham (1991) stated that, “environmental criminology argues that criminal events must be understood as confluences of offenders, victims or criminal targets, and laws in specific settings at particular times and places” (p. 2).

Environmental criminologists use theories within this area in order to identify spatial and temporal patterns of crime and environmental influences that explain their distribution over geographic areas, such as neighborhoods, cities, and districts (Andresen, 2019). Using findings from these types of environmental crime studies, criminologists are better able to find ways of predicting emerging crime problems and develop approaches to prevent crime or reduce crime rates (Wortley & Townsley, 2016).

Environmental criminology has a colorful history of disciplinary development beginning in the early 1800s. Methodologies and approaches catered to the geographic study of criminal events have continually advanced with the development of highly powerful analytic technological tools. As the discipline of environmental criminology has developed, it has become more important to find ways of understanding and categorizing the contributions of scholars in
this area. Following the initial development of environmental criminology, Brantingham and Brantingham (1991) identified three specific levels of analysis useful for studying crime through the environmental perspective – *macro, meso, and micro*. It is important to understand the ways in which each of these levels of analysis have been used historically in research within the area of environmental criminology to highlight why multi-level analyses of crime are vital to the continual advancement of our understanding of the distribution of criminogenic events.

Studies of the spatial distribution of crime emerged as early as the 1820s and 30s with the empirical contributions of André-Michel Guerry (1833) and Adolphe Quetelet (1831; 1835) who, using French crime statistics, created some of the very first recognizable crime maps, depicting the crime rates of the time within French departments (similar to counties within the United States or districts in England; see Beirne, 1993). Their findings were some of the first to highlight the uneven distribution of crime across France, as well as the differences in distribution based upon specific crime type studied. Higher rates of violent crime were identified in poorer rural areas, while higher rates of property crime were seen to occur in more wealthy, industrialized areas. Guerry and Quetelet began to reason that opportunity, not poverty, was one large contributing factor to the perpetration of crime. The role of opportunity has continued to fascinate and inspire criminological study within the area of environmental criminology through the last few hundred years and has continued to provoke important conversations about the perpetration and distribution of crime ever since.

The foundation of modern spatial criminology has built upon the work of Quetelet and Guerry following the research they conducted on French departments during the early 1800s. Research at the macro-level has contributed nuanced analyses on criminal patterns and trends
within a variety of geographic locations. Brantingham and Brantingham (1991) define macro-
level analysis as research that, “involves studies of distribution of crime between countries,
between states or provinces or cities within a particular country, or between the counties or cities
within a state” (p. 21). One example of the development of this research approach, “Localities of
Crime in Suffolk” by John Glyde (1856) began to examine smaller macro-level units of analysis,
specifically towns within a county in England. An additional example of macro-level
environmental criminological work includes that of Mayhew (1862), discussed in further detail
below.

Following early research conducted in this area, important contributions were made at the
turn of the century focused on analyzing crime at even finer scales. Influential researchers such
as Robert Park (1915), Ernest Burgess (1916), and Clifford Shaw and Henry McKay (1942;
1969) introduced strong bodies of work oriented on analyzing finer grained units of analysis,
specifically focusing on the neighborhood level. These contributions provided advanced
methodologies to examine the geographic distribution of crime within meso-level local areas of
interest, which were studied and built upon by researchers over decades of empirical work.
Brantingham and Brantingham (1991) define meso-level analysis as any research study that,
“involves the study of crime within the subareas of a city or metropolis” (p. 21). Research at the
meso-level was greatly developed during the 1960s and 1970s through the empirical and
theoretical contributions of Jane Jacobs (1961), Elizabeth Wood (1961; 1965), and Shlomo
Angel (1968) among many others who are discussed in greater detail throughout chapter 2.

Finally, more recent work in the discipline of environmental criminology has been
conducted at what is considered the micro-level of analysis. Brantingham and Brantingham
(1991) identify this level as particularly influential from the environmental perspective regarding the development of crime prevention strategies. The micro-level is focused on examining specific crime sites, oriented on elements of the built environment such as, “building types and its placement, landscaping and lighting, interior form, and security hardware” (Brantingham and Brantingham, 1991, p. 21-22). Researchers such as C. Ray Jeffery (1971), Oscar Newman (1972), and Lawrence E. Cohen and Marcus Felson (1979), in addition to others have greatly developed this area of environmental criminology. While micro locations of crime are not focused on within this research, it is important to note the contributions of these studies in the context of the development of environmental criminological studies and the future of this type of research. Their specific contributions are discussed in greater detail below.

2.1.1 Macro-analytic roots

Beginning with the contributions of Guerry (1833) and Quetelet (1831, 1835), macro-level analysis of environmental influences on crime are considered to involve the study of crime distribution between large areas including countries, states or provinces, cities within a specified country, or between state counties (Brantingham & Brantingham, 1991). Quetelet was the first to apply statistical methods to the social sciences, specifically in the area of crime (Andresen, 2019). Quetelet (1842) specifically showed that there were consistent and stable patterns of crime that persisted over time within French departments (equivalent to the size of a US county), now called ecological stability. Their research provided the foundation for modern spatial studies of crime and deviance conducted today.

Additional research in the 19th century throughout England found significant crime rate differences between counties, aligned similarly with the findings of Guerry (1833) and Quetelet
(1831, 1835). English spatial studies used larger cartographic units of analysis to eliminate some of the crime variation between coarser units of analysis, such as French departments (Andresen, Brantingham, & Kinney, 2010). These findings showed that higher crime rates were seen to occur within urban and industrialized areas than in rural areas (Wortley & Townsley, 2016). One example of this English research is that of John Gylde (1856) in his work on Suffolk County analyzing the differences in crime between towns. He contributed to research in environmental criminology by analyzing crime at a smaller level of aggregation, finding that significant variation of crime occurs between towns in Suffolk County, England. He argued that the location where a criminal resides matters more than the location of where criminal events occur when attempting to understand the distribution of crime (Andresen et al., 2010).

Glyde’s (1856) findings highlighted that higher crime levels occurred in towns where laborers aggregate together and that lower crime rates persisted in more rural distracts (Andersen, MacDonald, Bluthenthal, & Ashwood, 2013). Glyde was one of the first to show that variation in crime was hidden when using larger units of analysis (Weisburd, Bruinsma, & Bernasco, 2009). Additionally, he revealed that when researchers used these smaller units of analysis, significant differences were more easily uncovered in crime rates. Another notable discovery of Glyde’s showed middle-sized cities close to main roads and thoroughfares had crime rates higher than that of the mean of the larger area of which they were a part.

Henry Mayhew was another instrumental researcher who broadened our understanding of crime patterns and trends at the macro-level. Operating during the time period of the birth of sociology as a discipline, he published some of the strongest qualitative research pieces of the time. Mayhew’s (1862) work is one example of early ethnographic research using direct oral
testimony from guards, prisoners, and wardens in London prisons to investigate aspects of the criminal justice system in Britain. His research *The Criminal Prisons of London and Scenes of Prison Life* (Mayhew & Binny, 1862) analyzed crime areas, classifications, and the status of prisons in these areas, as well as, observations of juvenile delinquents, and finally methods of control and discipline of inmates. His research on London prisons recorded detailed statistics on arrests and convictions and asserted that the whole of London prisons lacked basic human necessities, some more deprived than others.

Mayhew’s research is some of the earliest to make a concerted effort to understand the relationship that existed between crime and other variables through the use of maps to document social conditions. In the fourth volume of his book *London Labour and the London Poor* (1862), Mayhew included detailed maps showcasing the geography of criminal statistics within each county of Britain. His geographical representations of criminal activities were some of the first to clarify the associations between crime and ecological variables such as poverty, urbanization, and disease building part of the foundation for modern spatial studies. His work reported statistics ranging from macro-level analyses to some of the very first attempts at micro-level analyses of geographic crime patterns, predating modern micro crime place literature by more than a century.

Two additional studies published on the cusp of the turn of the 20th century contributed to developing the study of macro-level crime patterns. One, conducted by Cesare Lombroso (1878), analyzed patterns of geographic distribution related to homicide and suicide between the north and the south of Italy. His study explored the differences in violent crime rates between these two large areas in relation to the southern population’s “racial inferiority” as he described it.
Since his work was first published, it has been widely recognized that Lombroso’s views are patently racist which invalidate his concluding assertions regarding the perpetration of violent crime. One final study worth mentioning was conducted by the French researcher Jean-Gabriel Tarde (1890). Tarde analyzed the relationship that occurred between crime and urbanization, comparing crime levels of geographically larger areas. His conclusion was that crime was being exported to rural areas of provinces from the cities where higher crime rates historically existed.

These macro-level studies were some of the first attempts to quantify the relationship between individual criminal events and their geographic location. As spatial studies of the relationship between environmental factors and crime rates continued, researchers moved from these large aggregation levels to smaller levels of aggregation to reveal more nuanced detail and combat limitations stemming from the use of macro-level units of analysis in earlier studies. Important work throughout the 19th century contributed vastly to criminologists’ understanding of the ways in which crime was distributed across geographic landscapes setting the stage for future researchers to uncover more nuanced relationships between criminal behavior and ecological elements of the built environment.

2.1.2 Meso-analytic roots

As studies of environmental criminology were further developed through the macro-level analyses conducted by researchers, interest in analyzing crime data at finer resolutions grew among scholars who desired to understand the geographic distribution of crime in greater depth. New additions to research in this area during the 20th century began to focus on ecological units smaller in aggregation, such as the neighborhood. As this line of inquiry became more popular, scholars identified important patterns and trends that have been shown to be both consistent and
stable across time periods and across geographic locations. The progression of environmental criminological research at the meso-analytic level has contributed greatly to our understanding of the geographic distribution of crime, as well as the spatial relationships that occur between criminal events and the built environment. This avenue of research continues to inform law enforcement approaches to the reduction of criminal events.

Two integral theories in this area include social disorganization theory and routine activities theory. Spatial and temporal analyses of criminal patterns and trends often employ the theoretical bases from these two environmental theories of criminology (Bursik & Grasmick, 1993a; 1993b). Social disorganization primarily focuses on variables related to the structural and demographic factors associated with community areas. Routine activities theory specifically defines three primary variables as facilitators to the occurrence of criminal activity. These three variables are a motivated offender, an attractive target, and a lack of capable guardianship (Cohen & Felson, 1979). Previous research that has been conducted to better understand the spatial and temporal elements of criminal activity has generally taken one of two approaches. The first of these approaches utilizes foundations from the Chicago School and the theoretical assertions of social disorganization theory, while others use the theoretical underpinnings associated with routine activities theory.

Highly influential researchers within the Chicago School contributed vastly to our understanding of the distribution of geographic patterns and trends of criminal events. Robert Park and Ernest Burgess (1925), using Park’s (1915) earlier conceptualization of the city as an institution and Burgess’s (1916) arguments regarding socialization in the social process, laid the foundation for the development of a model to depict the relationship between ecology and
community disorganization. Park (1915, p. 578) identified the city as an institution, made up of artifacts (charters, formal organizations, buildings, street railways, etc.) connected with the “vital forces resident in individuals and the community”; a growth of the undesigned product of generations of men’s labors. He viewed the city as having both a moral and a physical organization, influenced by the people who inhabited it and the basis of their human nature. Park then went on to outline what he considers, “the neighborhood” providing one interpretation of how we may categorize city sections based on their characteristics and that of those who inhabit them. Park (1915, p. 579-580) defines the neighborhood as, “a locality with sentiments, traditions, and a history of its own” without formal organization. Using this notion of a city, one built upon both the concepts of the city as an expression of human nature and the interplay between its moral and physical organization, researchers began to view the city structure as a dynamic, rapidly evolving reflection of the human spirit and its institutional character.

As Park began to introduce his conceptions of the city, Burgess commenced to publish on his notions of socialization in the social process. Burgess’s conceptualization of socialization purported that two distinct aspects of this socialization process existed, that of the group and that of the individual. Burgess (1916) explained that socialization of a group is influenced and defined by the “psychic articulation of the individual into the collective activities”, while the socialization of the individual was viewed as the participation in “spirit and purpose, knowledge and methods, decision and action of the group” (p.2). His primary thesis proposed that socialization, in place of geography or heredity, is the prevailing factor in the process of social evolution within scientific discovery and invention, social progress, and in an individual’s personal development.
Together, Park and Burgess began to build the foundation that led to the development of social disorganization theory. Park and Burgess (1925) outlined a model that depicted the relationship between the ecology of a city and the disorganization of communities based upon the definition of social disorganization, or a “decrease of existing social rules of behavior upon individual members of the group”, presented by Thomas and Znaniecki (1958, p. 1128). Park broke the city down into specific parts of what he refers to as a “superorganism” made up of interrelated symbiotic parts that create an “organic unity”. One element of this organic unity was referred to as a “natural area” or a region that comes into existence without design and performs a specific function for the broader ecological environment. Each natural area has a cultural history and distinguishable characteristics that separate these independent cultural units from one another (Park, 1952, p.80).

Two researchers who pull from the concepts first introduced by Park and Burgess (1925) and Thomas and Znaniecki (1927) were Mabel Elliott and Francis Merrill. Elliott and Merrill (1934, p.20) describe social disorganization as a relative term representing, “a breakdown in the equilibrium of force, a decay in the social structure, so that old habits and forms of social control no longer function effectively.” They argue that the dynamic nature of social interaction within society and resulting social change dissolves certain institutional relationships and behavior patterns changing the social structure. From this change, Elliott and Merrill (1934; 1961) believe social disorganization emerges, particularly when these changes occur more quickly than forces of reorganization. These authors believed that social disorganization could occur at three levels: personal, family, and community disorganization. Borrowing elements from Park and Burgess’ (1925) conceptions of the city and Charles Horton Cooley’s (1902) conceptions of human nature
and the social order, Elliott and Merrill (1934) describe the organic unity of the social structure as encompassing the individual and the group as various parts of the collective whole. They argue that the individual and the group are not two distinct phenomena, but merely two different vantage points from which we make observations.

Often citing the work of Thomas and Znaniecki (1927) in their publication *The Polish Peasant in Europe and America*, Elliott and Merrill take a different stance on conceptualizing social disorganization. While the authors acknowledge Thomas and Znaniecki’s stance that no connection exists between individual disorganization and social disorganization, Elliott and Merrill argue that these elements are essentially one in the same. Using the definition provided by Thomas and Znaniecki (1927, p.1843) of life organization, “that structure of attitudes and values which has grown out of the experience of each person, and through which, consciously or unconsciously, (s)he hopes to realize his basic purposes,” Elliott and Merrill build upon the concept to illustrate the place that the individual’s life organization has within the larger societal whole.

Of the three types of disorganization presented by Elliott and Merrill, the concept of community disorganization is the most directly related to the present work. In defining this concept, Elliott and Merrill first address the concept of “community”. They stress two elements of community – the psychological and geographic. Community can be viewed, they argue, as a “contiguous distribution of individuals and institutions” (1934, p. 569) or as a “congeries of spatially intimate social units” (Park & Burgess, 1924, p. 163). They argue that community disorganization is related most to the decay of interest in the political sphere of the community and the city. Two types of disorganization processes are described, the personal and impersonal.
Specifically, the personal process of disorganization arises from conflicts between older and younger generations and between older generations and basic social institutions (Elliott & Merrill, 1934, p. 572). Impersonal disorganization is argued to result from break downs that occur in institutional control. The absence of validity and the significant effect of institutions on the activities of individuals within the community can be manifested in many aspects of the community including the school, government, church, and within economic institutions.

Regarding the crime rate, Elliott and Merrill (1961, p. 536) believed it to be, “a major index to community disorganization because it is a measure of the degree to which citizens fail to live up to the community’s moral requirements.” Crime is identified as a community problem (Elliott & Merrill, 1934, p. 670), spurred on by the pattern of community-generated crime, the toleration of crime, the disorganization driven by crime, and the eventual induction of additional crime. The result: community disorganization. These authors acknowledge the importance of environment in providing location where crime is tolerated and accepted, and they name it as both a cause and effect of community level deterioration.

Another set of influential researchers, Clifford Shaw and Henry McKay (1942; 1969), drew from the previous work conducted by Park and Burgess, and began to develop the theory of social disorganization as it is most well-known today. Shaw and McKay developed their theory through publications of case studies (Shaw, 1930; Shaw, McKay, & McDonald, 1938) of juvenile delinquents. Shaw and McKay (1942) argued that the deterioration of structural conditions ultimately leads to neighborhood social disorganization. One of their most important contributions to the conversation on social disorganization pointed out a geographic and temporal relationship of juvenile delinquency events. In Shaw and McKay’s influential work,
Juvenile Delinquency and Urban Areas (1969), the authors outlined three primary factors that they believed contributed to the development of community level social disorganization: low economic status, ethnic heterogeneity, and residential mobility.

Shaw and McKay (1969) elaborated on elements of Park’s (1936) identification of the process of “invasion, dominance, and succession” to conceptualize what they called residential mobility. This process refers to the cultural succession that occurs within neighborhoods as a result of high residential population turnover. Residential turnover, believed to be one cause contributing to community disorganization (Boggess & Hipp, 2016; Hipp, 2011; MacDonald et al., 2013), in turn may also lead to elevated violent crime rates within a specific area. Their application of social disorganization to crime and delinquency considered only community-level disorganization, without addressing concepts of individual or familial disorganization as Elliott and Merrill had in the past. Instead, Shaw and McKay’s focus was placed upon outlining the theory of social disorganization as it operates within the neighborhood setting.

As social disorganization theory was being developed by scholars throughout the first half of the 20th century, others were beginning to develop new ways to theoretically explore criminal events based upon their geographic location and the various elements contained within their built environment. One example of meso-level analysis of the built environment conducted to inform reduction efforts on crime was contributed through the efforts of Jane Jacobs. Her work entitled, The Death and Life of Great American Cities (1961), contributed to the development of efforts to plan and execute crime reduction strategies. Jacobs believed that feelings of anonymity and isolation, as well as a lack of “natural guardianship” among residents of neighborhoods contributed to the occurrence of crime. She challenged basic concepts of urban
planning widely employed during the 1960s and 70s. These included city designs incorporating isolated neighborhoods, the notion that empty streets are safer than crowded streets, and the idea that a car driving down the street is progress over a pedestrian. She believed that these design elements would negatively impact the ability to develop social frameworks that the general public could base successful self-policing techniques on in their neighborhoods. Her work contributed to Jacobs’ belief that a lack of meaningful interaction between neighbors results in the occurrence of crime.

Jacobs asserted that planning policies aimed at curating a sense of community were one way to reduce feelings of isolation and anonymity among residents. She outlined four conditions of urban design that could be used to achieve this goal: 1) districts should cater to multiple purposes; 2) districts should be divided into small blocks with interconnecting streets and frequent corners to limit dead zones and deserted backstreets; 3) the districts should have a mixture of newer and older buildings in order to support a diverse array of enterprises; and finally 4) a sufficient concentration of population density is necessary to support diversity and facilitate interaction between residents (Jacobs, 1961).

Additionally, she identified three elements necessary for safer city streets, including: 1) public and private space should be clearly marked; 2) each area should be used for diverse purposes; and 3) cities should encourage high levels of pedestrian usage of sidewalks (Jacobs, 1961). These planning principles were designed to draw people out to the streets, creating an environment for interaction among community members which would inadvertently build stronger social networks and familiarize the community with individuals who worked, lived, and visited the area. This interaction would in turn, encourage the formation of what Jacobs called,
“the eyes of the street”, a social surveillance mechanism. Her work predated the popular concepts of Jeffery’s (1971) *Crime Prevention through Environmental Design (CPTED)* and Newman’s (1973) *Defensible Space*, which will be discussed in further detail below.

Another lesser-known contributor to this area of environmental criminology is Elizabeth Wood. Wood, a former social worker and advocate for housing change, served as the founding director of the Chicago Housing Authority from 1937-1954. During her time working for the Chicago Housing Authority, Wood (1961; 1965) developed guidelines to address security issues placing an emphasis on design elements that support natural surveillability. In the 1950s, Wood urged Chicago planners to limit any unused public gathering areas by including commercial spaces for community members, arguing that this would allow for loitering among community residents and minimize potential crime opportunities (CSC Oral History Research Program, 1954). Wood proposed that public housing designs should reflect the surrounding shorter story buildings to maintain traditional relationships between the street and dwellings within an area. She believed that if this relationship was made a reality, an overall reduction in crime would occur within public housing communities.

She introduced her social design theory in *Housing Design: A Social Theory* (1961) which advocated, much like Jacobs’ work, for the observance of a sense of community. At the crux of her social design theory, Wood argued that the influence of urban design on resident behavior ultimately influences crime rates within an area. This assertion shaped and informed some of the leading ideas and policies that were prevalently used in the design of public housing in the late 60s and early 70s. Wood believed that communities naturally tend to aid upward mobility (1961) and outlined general, conceptual proposals for city implementation of resources
and institutions oriented on helping individuals achieve personal goals (Wood, 1965). Wood also claimed that the natural progression of the city structure favors homogenous development of communities. In her work, she notes that there are inherent issues to homogenous development of communities but fails to offer clarification on what she calls the “balanced neighborhood”. Wood discusses the potential of heterogeneity in solving social ills within the city including racial segregation, economic segregation, and the segregation of old or socially maladjusted persons.

In addition to Jacobs’ (1961) work, the thoughts outlined by Wood contributed to the foundation of C. Ray Jeffery’s (1971) CPTED, Oscar Newman’s (1973) Defensible Space, and other surveillance-based approaches to crime reduction. Wood was one of the first researchers to suggest that the place itself was an important variable (risk factor) in the context and commission of criminal actions. Her realization of the role that the physicality of buildings plays in the facilitation of social control influenced publications of hers that highlight the importance of integrating architecture and social controls to create safe and secure spaces.

Another researcher, Shlomo Angel, student of Christopher Alexander, was one of the first pioneers of CPTED. In his PhD thesis, “Discouraging Crime Through City Planning” (1968), Angel studied street crime occurring in Oakland, CA. Angel asserted that an inverse relationship occurred between crime and the level of activity on the street. Angel (1968, p.15) stated that, “the physical environment can exert a direct influence on crime settings by delineating territories, reducing or increasing accessibility by the creation or elimination of boundaries and circulation networks, and by facilitating surveillance by the citizenry and the police.” He stated that commercial strips were one area particularly vulnerable to crime because they disperse street
activity thinly within an area, increasing the ease with which individuals are able to engage in street crime.

In Angel and Hyman’s (1972) article, “Urban Spatial Interaction”, the authors focus on developing a geometrical representation of movement and spatial interaction within urban areas to demonstrate the changes occurring in city structures since the development of Park and Burgess’ (1925) concentric zone theory. Angel and Hyman’s (1972) use of the geometrical representation of urban space associated quantities of interest with a continuous coordinate system, showing that each point of interest is uniquely located in geographic space. They show that each object is associated with one discrete set of coordinates within this continuous coordinate system, highlighting that findings derived in studies using these methods are able to be discussed in terms of quantity distribution in space showing discernable patterns of phenomena (e.g. Park et al., 1925; Clark, 1951; Alonso, 1964). Their work in this article is of great importance in demonstrating researchers’ ability to construct continuous models of urban spatial interaction showing patterns and trends of phenomena, such as homicide, in relation to geographic locations of interest. Their research contributes to the development of what we now consider geographic information systems (GIS) approaches to studying crime and developing crime prevention strategies within large urban areas in the United States and abroad.

2.1.3 Micro-analytic roots

An even finer grain of analysis, described by Brantingham & Brantingham (1981) as the micro-analytic level, has gained more widespread popularity for use in environmental criminological research within the past forty years. The micro-level of analysis has been noted as being particularly influential in the development of environmental crime prevention strategies.
Brantingham and Brantingham describe this level as one that examines specific crime sites, focusing on, “building type and its placement, landscaping and lighting, interior form, and security hardware” (p.21-22). Micro analytic approaches generally reflect a reductionist philosophy, where focus is placed on the smaller constituent parts of the whole in an effort to study specific elements of the immediate environment and their effects on individual’s behaviors and decisions (Wortley & Townsley, 2016). These approaches draw heavily from debates of individual level psychological differences in traits assumed to drive behavior and the variation that occurs in these internal constructs between individuals.

Informed by the work done at the meso-level in the 1960s and 70s, the micro-analytic approach encompasses studies that specifically focus on analyzing characteristics of the built environment that may influence the occurrence of criminal activity. Specifically, this section will outline the contributions of such researchers as C. Ray Jeffer (1971); Oscar Newman (1972); Cohen and Felson (1979); and Paul and Patricia Brantingham (1981; 1991).

C. Ray Jeffer was one researcher who expanded the utilization of concepts stemming from research conducted in the late 50s and early 60s to establish a specific approach to the reduction of crime. The first to coin the term “environmental criminology”, Jeffer’s Crime Prevention Through Environmental Design (CPTED) approach, described in a book he published by the same name in 1971, was partially inspired by the work of Jane Jacobs and her discussions of the positive effects of street surveillance by neighbors, which she called “natural surveillance”. Embedded within the approach were central psychological concepts taken from B.F. Skinner’s (1953) learning theory, including his operant conditioning models. Jeffer (1971) emphasized the physical environment’s role in the development of an offender’s painful and
pleasurable experiences, where these experiences would have the capacity to change behavioral outcomes.

In his second version of the book, published in 1977, Jeffery expanded the theory to adopt a more complex model of behavior. In this model, a reciprocal relationship was outlined between variable physical environments, individual offender behavior, and the behavior of individuals within the general public. This relationship made it possible for a model to be developed that not only predicted the effects of external environmental modification, but also predicted the effects of modification of the internal environment of individual offenders. As he continued to develop CPTED, he began to emphasize the role of material rewards and the physical environment in approaches attempting to control behavior (Jeffery & Zahm, 1993, p. 330). He advanced his argument for CPTED in the 1990s to include the standing basic assumption of the approach where,

“the response [i.e., behavioral adaptation] of the individual organism to the physical environment is a product of the brain; the brain in turn is a product of genetics and the environment. The environment never influences behavior directly, but only through the brain. Any model of crime prevention must include both the brain and the physical environment (Jeffery & Zahm, 1993, p. 330).”

Jeffery’s primary belief was that the design of the physical environment was the key to crime control, in addition to the implications of social policies aimed at increasing risks for offenders when committing criminal behavior. He believed that crime could not occur without opportunity, rather his approach was one of situational determinism. Stated in his second version of CPTED,
“There are no criminals,” he declared, “only environmental circumstances that result in criminal behavior. Given the proper environmental structure, anyone will be a criminal or non-criminal (Jeffery, 1977, p.177)”.

Jeffery’s contributions to the development of predictive approaches to crime control through the physical environment built upon the momentum of earlier researchers and provided a platform for others to continue to enhance and improve upon the models he outlined.

Oscar Newman’s *Defensible Space* (1972) quickly overshadowed the work of Jeffery because of its conceptual clarity and straightforward approach to addressing physical environmental factors to reduce the opportunity for crime. *Defensible Space* (1972) was written to address the relationship that occurred between urban design and crime occurring in public housing communities. Some elements from Jacobs’, Wood’s and Angel’s work could be seen in the approach adopted by Newman, implemented to reduce opportunity for successful criminal behavior in the built environment. Emphasis was placed on outlining specific design elements, for example reducing the amount of open space without purpose within a community, which addressed a missing component of Jeffery’s work. His arguments were based on data analysis of crime instances occurring in St. Louis’ and New York City’s public housing developments and observations he made while he was an educator as Washington University in St. Louis and as the director of the Institute for Community Design Analysis in New York City.

Newman defined defensible space as, “…a model which inhibits crime by creating a physical expression of a social fabric which defends itself” (Lab, 1992, p.19). Two primary components were introduced in the first iteration of his crime reduction approach: 1) the utilization of defensible space concepts should allow individuals to see and be seen on a
continual basis, and 2) individuals within the area must be willing to report crime or intervene at the time of occurrence. Newman extends the argument previously made by Jacobs that residents must take responsibility for crime within their immediate neighborhoods. Outlining four defensible space protocols (territoriality, natural surveillance, image, and milieu), Newman endeavored to establish a concrete set of protocols to enhance urban environmental design with the goal of reducing community crime rates. Elements of Newman’s integrated approach to crime reduction can be seen in modern day policies and procedures outlining the architectural development of housing complexes as well as within applications of opportunity-based approaches to crime reduction.

Following the development of Newman’s original conception of defensible space in the 1970s, researchers moved to improve the approach by integrating concepts of CPTED. Expansions of opportunity-based crime reduction efforts following the development of Jeffery’s CPTED and Newman’s Defensible Space sought to address physical components of crime prevention as well as social and psychological characteristics of known offenders. Additionally, researchers attempted to address the question of whether these measures of physical restriction regarding criminal opportunity actually led to the reduction of crime or the displacement of crime to other locations.

Additional theoretical developments during the late 70s and early 80s in environmental criminology can be attributed to work conducted by Cohen and Felson for their introduction of routine activities theory. Departing from other popular theories of criminological exploration, routine activities theory focuses on the actions of individuals instead of placing focus on the neighborhood environment and its changing characteristics. The underlying concept of human
 ecology in routine activities theory, rather than Shaw and McKay’s focus on social ecology, incorporates elements of not only physical space but also temporal factors of criminal behavior (Andresen, Brantingham, & Kinney, 2010). By including both spatial and temporal components of criminal activity, researchers are better able to evaluate the role of opportunity regarding criminal events.

Cohen and Felson (1979, p. 593) define the concept of routine activities as, “any recurring and prevalent activities which provide for basic population and individual needs, whatever their biological or cultural origins”. These authors posit that when changes occur in our routine activities, changes also occur in crime rate trends. Generally, we use routine activities theory to study direct-contact predatory violations (e.g., robbery, assault, homicide, etc.). Each of these violations engages three components: a motivated offender, an attractive target, and a lack of capable guardianship. These elements, converging in time and space create opportunity for criminal events to occur. Changes that occur in the nature of the convergences of these three elements are believed to lead to changes in crime.

Major changes occurring in the economy of the United States after the Second World War have been identified as primary catalysts for large scale changes in property and violent crime rates. Increased income levels led to substantial changes in the normal routine activities of individuals. Disposable income made it possible for individuals to begin venturing out of the home to participate in recreational activities, increasing the amount of time spent away from the “protective” environment of the home. Additionally, changes in consumer products, the advancement of technology in the post-war era, and increasing numbers of women entering the work force were all indicated to contribute to the shift in routine activities during this period.
Fewer people were in the home to protect newly acquired property items (specifically, expensive lightweight electronic equipment), thus elevating the likelihood of victimization.

Testing of this theory has occurred at all three levels: macro, meso and micro. At the macro level, initial testing conducted by Cohen and Felson (1979; Felson and Cohen 1980; 1981) revealed that the presence of young populations and single-person households increased burglary rates, implying that increased activities conducted outside of the home elevated the likelihood for crime to occur. Additional testing at the meso level by Andresen (2006a) showed that the theoretical concepts embedded within the theory could be used to predict spatial variation in criminal activity. Finally, micro level testing of this theory regarding criminal victimization revealed that single young men with lower incomes and routine daily activities taking them away from the home (e.g., work, sporting events, recreational activities, etc.) have significantly higher rates of victimization than those who do not engage in these routine activities (Kennedy & Forde, 1990). Overall, empirical analyses of routine activities theory have shown us that individual actions and places impact rates of victimization.

Following the developments of the social disorganization and routine activities approaches, the geometric theory of crime was introduced to analyze the convergence of offenders, targets, and opportunity in an individualized context. Specifically, using the foundations of Jeffery’s work, this theory focuses on the environmental backcloth, or the contextual elements of an environment that make it unique and dynamic. These contextual elements include the built environment, institutions, social and cultural norms, and many other factors that contribute to the ecology of a space. Brantingham and Brantingham (1993) discuss this dynamic environment in reference to the ever-changing social and cultural landscape of our
activity spaces. Using Kevin Lynch’s (1960) conceptualization of the four primary elements of a city (nodes, paths, districts and edges), Paul and Patricia Brantingham further developed the application of these concepts to the occurrence of crime in time and space.

Nodes, or the places which we frequent, are conceptualized as points in time and space. These nodes exist along pathways, or the channels (e.g., streets, walkways, public transit, etc.) that we travel to get from place to place. Districts, which can be visualized using polygons of geographic areas, are regions within cities that have common elements and identifying features that differentiate them from other districts. Finally, edges are boundaries between these regions which may include distinct and physical elements of the landscape (e.g., railroad tracks, waterways, etc.) or gradual changes between spaces (Lynch, 1960). Brantingham and Brantingham (1981) use the concepts of nodes and paths to create maps of places and the pathways between them, representing activity spaces. As individuals interact within these activity spaces, they begin to develop a sense of place, or knowledge of and attachment to particular areas within their awareness space. Thus, most victimization will occur within our activity space because it is where we spend the majority of our time.

High-intensity search areas, or those areas immediately surrounding activity nodes and paths of offenders are identified by Brantingham and Brantingham (1981) as the primary search areas for criminal opportunity closely coinciding with offender’s activity and awareness spaces. Activity patterns are fairly similar between offenders and non-offenders within the same environment. Because of this similarity, individuals become victims of crime when their activity spaces overlap with offender’s activity spaces. The geometric theory of crime provides a way to predict the specific patterns of various crime types. Within the nodes of activity, crime is not
randomly or evenly dispersed, rather, crime is concentrated in particular areas within these high crime locations. One prediction of this theory asserts that the majority of crime occurs in a small percentage of the given geographic area, concentrated around nodes and paths that are frequented by offenders. Generally, the theory has been used to understand geographic crime patterns. The concepts embedded within the geometric theory of crime can be used to inform the study of violent crimes using geographic information systems (GIS) technology to provide larger breadth and depth of our understanding of violent crime patterns that occur within specific locations at the micro level.

The first portion of the literature review has outlined the formative developments of environmental theories of crime used to study the patterns and trends of criminal behavior in our geographic world. The development of these theories has shaped the way we study the geography of crime, providing the foundation for the present work analyzing homicide events in Baltimore, MD. Many of these contributions have continued to expand in both theoretical and practical application techniques which will be further explored throughout this dissertation. Following this section, a discussion of the ways in which environmental crime approaches have been used to answer important questions regarding violent crime, specifically homicide, will be explored. Section 3.1 provides a concise discussion of influential literature published on homicide patterns in urban places. Section 3.1.1 covers the empirical contributions made to research utilizing foundations from social disorganization theory. Section 3.1.2 outlines important contributions made to the literature on violent crime using the foundations from routine activities theory. Section 3.2 addresses the limitations of previous studies. Additionally, section 3.3 outlines the approach taken in the current study. Finally, section 3.4 discusses the
contributions this work makes to criminological research conducted in this area and possible future policy implications.
CHAPTER THREE: HOMICIDE IN URBAN PLACES

3.1 Urban Homicide

Primarily, focus will be placed upon research utilizing the concepts derived from two popular theoretical approaches: social disorganization theory and routine activities theory. Articles based upon the theory of social disorganization often focus on the ecological distributions of crime within small units of analysis including neighborhoods, measured using census boundaries such as blocks, block groups, and census tracts (Browning et al., 2010; Hipp, 2007; Peterson and Krivo, 2010; Sampson and Groves, 1989; Sampson, Raudenbush, and Earls, 1997). Research articles that employ the theoretical arguments expressed in routine activities theory often focus on a variety of aggregate levels of crime locations, including both meso- and micro units of analysis such as communities or neighborhoods and street segments (Andresen and Malleson, 2015; Andresen and Malleson, 2011; Steenbeek and Weisburd, 2016; Weisburd et al., 2004; Weisburd, Groff, and Yang, 2012; Wikstrom et al., 2010).

A smaller portion of the literature focuses on analyzing the spatial and temporal patterns and trends in violent crime and has attempted to synthesize concepts from both theoretical foundations (Andresen, 2006a; Smith, Frazee, and Davidson, 2000). By incorporating measures from both theoretical areas, researchers have attempted to bridge gaps between spatial and temporal evaluations of criminal events (Andresen, 2006a; 2006b; Daday et al., 2005). Similar to these more integrative studies, the current paper seeks to utilize elements from both theoretical areas to better explain spatial and temporal patterns and trends in homicide occurring within the city of Baltimore.
3.1.1 Social Disorganization and Homicide

Beginning with those approaches that have solely drawn from the theoretical foundation laid by social disorganization theorists, important contributions to the violent crime literature in this area will be explored. First popularized through the work of Elliott and Merrill (1934; 1961) and Shaw and McKay (1942; 1969) and developed by a host of others, social disorganization theory has been used to explore macro-level patterns and trends of violent crime geographically. Research in this area typically tends to analyze data at the neighborhood level using census block, block group, or census tract boundaries to aggregate violent crimes depicting emerging relationships between these crime variables and surrounding environmental factors (Browning et al., 2010; Hipp, 2007; Peterson and Krivo, 2010; Sampson and Groves, 1989; Sampson, Raudenbush, and Earls, 1997).

Within social disorganization theory there are three primary variables which have been tested using macro-level models to better understand their influence on community level disorganization. Shaw and McKay identify the first of these primary variables as low economic status, measured using a range of variables including poverty, unemployment, median household income, or through the use of a disadvantage score (Poole et al., 2018; Morenoff, Sampson, & Raudenbush, 2001; Sampson & Wilson, 1995; Ulmer et al., 2012; Wilson, 1987). The second primary variable, ethnic heterogeneity has been captured by employing several indices including Blau’s Index and the Herfindahl Index (Altheimer, 2008; Avison & Loring, 1986; Chon, 2012; Sampson & Groves, 1989) to measure the distribution of race and ethnicity across geographic space. Finally, geographic mobility, a measure often employed to assess the levels of residential mobility within an area has been measured through evaluating variables such as the percentage
of vacant or rented housing within an area or by analyzing the percentage of the population who
have resided within the area for five years or more (Boessen & Hipp, 2015; Boggess & Hipp, 2010; Hipp, 2011; MacDonald et al., 2013).

Each of these primary variables is believed to elevate violent crime within an area
through mechanisms disrupting the social organization of a community. Shaw and McKay
(1942) argue that higher levels of low economic status elevate rates of delinquency existing in
areas of low economic standing. Additionally, they posit that population composition derived
from the ethnic heterogeneity of an area helps us to explain the relationship that occurs between
areas of increased delinquency and high concentrations of foreign-born populations and Black
heads of families. Finally, these researchers describe a term they entitle physical status,
representative of areas with high industry or commerce and the elevated rates of population
turnover that occur within these places. It is argued that crime rates are elevated within these
areas as a result of the continual change in population composition over time (Shaw & McKay,
1969). Structural barriers resulting from these variables are believed to hinder the development
of both informal and formal social ties between community members (Parker & McCall, 1999)
and increase the level of social disorganization within a community through the disruption of the
community’s ability to maintain social control (Bursik, 1988; Bursik & Grasmik, 1993; Sampson
& Groves, 1989). Regarding homicide, a number of studies have attempted to uncover patterns
between elements of the three primary variables and fluctuations in homicide rates of particular
geographic areas.

Studies that have been conducted to better understand the linkages between economic
factors and homicide have often employed a measure of economic deprivation (Avison &
Loring, 1986; Blau & Blau, 1982; Kubrin & Herting, 2003; MacDonald & Gover, 2005; Messner, 1982; Messner, Raffalovich, & McMillan, 2001; Pridemore, 2002, 2008). However, many studies have been highly criticized for their failure to establish a macro-social model that relates economic deprivation to homicide (Chamlin & Cochran, 2005; Lee, Martinez, & Rosenfeld, 2001). More recent studies evaluating the impact of economic measures on homicide have identified income inequality (Burraston et al., 2018; Krohn, 1976; Messner, 1982) as a reliable predictor of violent crime at the macro level, though inconsistency of the strength of this measure has been identified through empirical testing of its relationship with crime (Hagan, 1995; Messner, Raffalovich, & Shrock, 2002). One example of this research identified income inequality as an important measure when analyzing homicide rates in democratic societies (Krahn, Hartnagel, & Gartrell, 1986) and additional research has identified the measure as having a robust relationship with homicide in one cross-sectional analysis (Messner et al., 2002).

Another measure aiming to capture the relationship between homicide and economic status, identified as absolute deprivation, has been analyzed over many years of research. Usually measured as an index of disadvantage, absolute deprivation has been shown as a reliable and consistent predictor of violent crime at the macro level (Land et al., 1990; McCall, Land, & Parker, 2010; Pratt & Cullen, 2005). One component of absolute deprivation, poverty, has held up as an important component of identified correlated causes of homicide at the macro level (Messner & Rosenfeld, 1999; Pridemore, 2008). Most recently, researchers have uncovered a significant moderating relationship between income inequality and disadvantage on homicide counts (Burraston, Watts, McCutcheon, & Province, 2019). The interactive relationship between relative and absolute deprivation on homicide establishes that as absolute deprivation
(disadvantage) increases, homicides increase also which aligns with previous research conducted in this area (Land et al., 1990; McCall et al., 2010; Pratt & Cullen, 2005; Pridemore, 2002, 2008). Additionally, these authors have shown that the relationship between relative deprivation (income inequality) and homicide counts, while significant, tapers off as absolute deprivation (disadvantage) increases. Studies in this area demonstrate the importance of evaluating a variety of economic measures to establish reliable findings regarding the relationship that occurs between economic factors and homicide.

Research conducted analyzing the racial and ethnic distributions of communities has shed light on some of the assertions made earlier by Shaw and McKay (1969) in their earliest analyses of social disorganization theory. A number of scholars have denied the proposed correlation between elevated rates of immigrant individuals and increased homicide rates (Lee et al., 2001; Martinez, 1996; Sampson, 2008). Sampson (2008) points out that individuals who immigrate generally tend to have lower predispositions to engage in homicide and higher motivations to work in order to avoid deportation. Additionally, Lee et al. (2001) tells us that that members of the Latin community generally present low levels of involvement in cases of homicide despite the pervading issues of residential segregation and poverty within their neighborhoods.

Supported by studies in homicide research that attempt to establish a relationship between racial and ethnic segregation, poverty, and homicide, it has been noted that the unequal distribution of resources between communities promotes social anomie (Martinez, Jacob, Stowell, & Lee, 2010; Morenoff, Sampson, & Rondenbush, 2001) which in turn, elevates the disorganization of communities.
Finally, studies conducted on understanding the effects of residential mobility on homicide have increased our knowledge regarding structural factors’ influences on changing crime rates. Often mobility is measured through measures of residential instability, recorded as the percentage of the population living in a different location than 5 years prior (Parker, Mancik, & Stansfield, 2017; Stansfield, Williams, & Parker, 2016). Residential instability has been shown to be significantly related to homicide for various age groups, with greater estimated effects for adolescents and young adults (Boggess & Hipp, 2010; Land et al., 1990; McCall et al., 2010; Stansfield et al., 2016; Warner & Rountree, 1997). Additionally, residential mobility was shown to be a positive and significant control measure related to longitudinal homicide trends in periods after the drop in crime that occurred during the 1990s (Parker et al., 2017). Research conducted by Regoezzi and Jarvis (2013) identified residential instability as a factor negatively affecting the identification, apprehension, and prosecution of homicide suspects which has an overall effect on homicide clearance rates. While researchers have noted the significant effects of residential instability on crime rates, they have also acknowledged that relations between these variables are not well understood (Boggess & Hipp, 2010; Warner & Rountree, 1997).

Overall, explorations of primary factors identified in the theoretical area of social disorganization have increased our understanding of structural factors related to homicide patterns and trends. These macro-level factors, in conjunction with individual-level factors outlined within routine activities theory have the ability to further expose the role that the environmental context of geographic areas play in the fluctuation of homicide patterns and trends. In the following section, literature utilizing the concepts derived from theoretical
evaluations of routine activities theory variables will be explored in the context of homicide events occurring within the United States. This exploration of the literature will inform the current study’s approach to integrate both theoretical areas in a model that evaluates the changing patterns of homicide regarding not only the spatial context of these crimes, but also the temporal context of homicide incidents.

3.1.2 Routine Activities Theory and Homicide

Researchers employing the routine activities perspective to investigate violent crime patterns have commonly used the theoretical underpinnings of the approach to analyze the role that the built environment plays in influencing crime. Oriented in the concept of opportunity, routine activities theory has been employed to establish the notion that specific places are more conducive to criminal opportunity than others. Areas that offer elevated opportunity for offenders to engage in criminal behavior generally contain what are referred to as attractive targets and lack the surveillance from capable guardians necessary to deter crime elevating the likelihood that crime will occur in these places (Cohen & Felson, 1979). Cohen and Felson (1979) assert that the convergence in time and space of these three elements (motivated offenders, suitable targets, and the lack of capable guardianship) are necessary for crime to occur. Research from Brantingham and Brantingham (1984; 1991) has shown that most often, crime occurs in areas closest to both offender’s and victim’s activity spaces, or the locations in which they reside, work, and engage in recreational activities. Particularly, research in this area has shown that homicide incidents occur in close proximity to the primary residents of victims and offenders (Groff & McEwen, 2006; Messner & Tardiff, 1985; Rand, 1986; Tita & Griffiths, 2005).
Alterations in the daily routines of individuals following World War II have significantly shifted the opportunities for crime in a few fundamental ways, previously discussed above. This shift in the distribution of opportunity for crimes against persons has been influenced by the changing patterns of mobility individuals engage in while pursuing daily activities. Routine activities theory has been used by researchers to evaluate the spatial and temporal aspects of victimization and criminal behavior (Block, 1981).

Violent crime research oriented in the foundation of routine activities theory has been conducted using a variety of methodologies. Spatial and temporal elements of criminal offending and victimization have been studied to better understand the situational characteristics of specific incidents. Research at both the individual and macro levels has shed light on the role that demographic, economic and social factors play in the commission of violent crime (Andresen 2006a; 2006b; Graif et al., 2014; Sampson & Wooldredge, 1987). These studies have used a variety of measures to capture the concepts of motivated offenders, suitable targets, and attractive guardians. Regarding the concept of a motivated offender, researchers have primarily used proxy measures (percent of the population within primary offending ages [15-29] and the rate of violent crime offenders in violent crime categories) to evaluate the role that this variable plays in the occurrence of criminal events (Andresen, 2006b; Tewksbury, Mustaine, & Stengel, 2008). Attractive targets have been measured using various constructs including indices created by combining variables such as population size, the number of dwellings, average family income, and dwelling value, as well as the percentage of rental residences (Andresen, 2006a; 2006b). Finally, population density has been used as a proxy measure for the concept of capable guardians (Andresen, 2006a; 2006b).
Routine activities theory has been shown to be an important theoretical contribution to the study of homicide patterns and trends. Previous studies using this foundation have shown that the framework of routine activities theory is consistent with homicide patterns, particularly concerning the relationship between varying sociodemographic characteristics and risks of victimization (Messner & Tardiff, 1985). These researchers showed that victims of homicide who centered routine activities of their daily lives around their home were more likely to be victimized in their residence by a family member. They also revealed that travel distances were shorter for the commission of a crime when the victims and offenders had closer social ties. More recent research has suggested that both individual and event characteristics of homicide mobility patterns can be explained by the routine activities of offender and victim daily lives (Pizarro et al., 2007; Tita & Griffiths, 2005). Tita and Griffiths (2005) showed that tighter social bonds were most likely to be present in internal (within neighborhood) homicide, supporting the finding that participants traveled shorter distances in these incidents. Finally, in an analysis of different homicide types, Pizarro et al. (2007) revealed that homicide incidents involving gang members usually involved longer travel distances, where homicides involving familial and other intimate relationships generally involved shorter travel distances.

Additional research in this area has demonstrated that the routine activities of actors and the situational characteristics of homicide events correspond to specific types of homicide mobility patterns (Tita & Griffiths, 2005; Groff & McEwen, 2007). In one recent publication, Corsaro, Pizarro, and Shafer (2017) provided evidence for the finding that planned aggression is a robust predictor regarding offender mobility homicides (where an offender travels to the victim’s residence). Routine activities theory was demonstrated as a useful theory to explain
victim mobility homicides, characterized by a more spontaneous confluence of necessary variables for a homicide to occur. In tandem with the foundations of social disorganization theory, routine activities theory provides a foundation to conduct exploratory analyses of homicide patterns and trends regarding both spatial and temporal variables. By combining the two theories, a more deeply nuanced understanding of the environmental influences of homicide events can be ascertained at multiple levels. Constructs from these theories can be applied at each level of analysis: macro and meso. The final sections of this introduction will explore the limitations of prior research in this area as well as the context of the current work and the contributions it will make to the criminological study of homicide.

3.2 Limitations of Prior Literature

Very few studies have been conducted using the theoretical underpinnings of both social disorganization theory and routine activities theory to study homicide within the area of environmental criminology. Early revitalization efforts of social disorganization research during the late 1980s and early 1990s has emphasized the social control process at multiple levels within the social disorganization approach (e.g., Bursik, 1988; Bursik and Grasmick, 1993; Farrington et al., 1993; Sampson and Groves, 1989). These levels include the private level, or primary relational networks, parochial level, secondary relational networks, and the public level, considered to be any governmental networks (Smith, Frazee, & Davidson, 2000). Additional research was conducted to establish operational definitions and better understandings of the relationships between theoretical elements of routine activities theory and crime were also completed during this time period (e.g. Clarke, 1979; 1980; 1983; 1984; Cohen, 1981; Felson, 1986; Felson & Cohen, 1980).
In the 1990s and early 2000s, researchers proposed the integration of these two theories to improve the predictive power of spatial analyses of crime incidents (Kennedy and Forde, 1990; Miethe & Meier, 1990; Rice & Smith, 2002; Sampson and Lauritsen, 1990; Sampson and Wooldredge, 1987). One study conducted by Miethe, Hughes, and McDowall (1991) examined homicide rates in U.S. Cities during the decades 1960, 1970, and 1980. Their analysis showed that variations in measures of social disorganization and routine activities patterns helped to explain temporal changes in homicide rates, supporting both perspectives. Specifically, the authors found that ethnic heterogeneity, household crowding, and the unemployment rate were associated with changes in homicide rates over time. More recently, Weisburd, Groff, & Yang (2012) used the foundations of these initial attempts to integrate social disorganization and opportunity-based theories of crime to further refine and strengthen the observations made previously and propose one explanation for observed crime concentrations. Though their study focused on the exploration of crime concentrations at the street segment level, Weisburd et al. (2012) provide one of the first in-depth examinations of both social characteristics and situational opportunities of violent crime at a micro-level of aggregation. These authors found support for the opportunity measures used in their study, and additionally uncovered associations between social disorganization measures and streets under analysis.

Braga and Clarke (2014) assess the theoretical contributions made by Weisburd et al. (2012) and assert that future research in this area should attempt to include not only variables representative of the three individual constructs of routine activities theory, but additional measures representing the convergence of the three variables. Overall, while this piece is a major contribution to furthering our study of crime in urban locations, more research is necessary to
meaningfully advance our understanding of violent crime occurring in urban locales. One way in which to do this is by integrating analyses at multiple levels of aggregation within criminological studies so that we may better capture changes that occur in the relationship between homicide and other demographic, economic, and social factors.

Very few studies have attempted to evaluate patterns of homicide at varying levels of aggregation. One study conducted by Sharkey (2010) evaluated the effect of local homicides in Chicago on children’s cognitive performance using the block group, census tract, and neighborhood cluster levels of aggregation. He found that children exposed to a local homicide had substantially reduced performance on cognitive assessments within a short period following the event. Effects appear strongest at the block group level, with decreasing strength as the distance between a child’s home and the location of the homicide increased at both the census tract and neighborhood cluster level. Additionally, a multi-level study conducted by Smith and Sandoval (2018) using both the census tract and 1000-m raster grids as geographic units of analysis uncovered interesting differences between homicide and social, economic, and racial determinants. Using both meso and micro-level scales to address limitations stemming from the Modified Aerial Unit Problem (discussed below), these authors revealed that there were no significant relationships between independent variables and homicide at the census tract level, but significant relationships were uncovered using 1000-m raster grids as the unit of analysis, demonstrating the importance of evaluating these relationships between varying levels of aggregation. While these studies have contributed to our understanding of the differences that occur in the relationship between homicide and varying demographic, economic, and social factors there is much work to be done to investigate these findings further.
Consideration must be given to a well-documented limitation occurring in the spatial study of homicide events known as the Modifiable Aerial Unit Problem (MAUP). The MAUP is one issue researchers run into when conducting geospatial analyses at a variety of aggregation levels. The MAUP was first discovered by researchers Gehlke and Biehl (1934) who reported that, “the correlation coefficient for variables of absolute measurement increases when areal units are aggregated contiguously, but there is little equivalent trend for ratio or percentage variables” (Wong & Fotheringham, 1990). The term MAUP was first coined and described by researchers Openshaw and Taylor (1979) who named it so because it acknowledged the artificial demarcation of many geographic unit boundaries, for example census enumeration units, which are subject to be redrawn based upon a variety of criteria. Essentially, when analyses are conducted over data collected according to different boundary definitions, multiple data sets are created, and this generally provides inconsistent results.

On the Earth’s surface, there are very few uniform geographic surfaces. This creates an issue when we aggregate or disaggregate geographic boundaries. When we create larger units from merging slightly different smaller neighboring units, the original values of these units are averaged at the aggregated level. Likely, after this process is complete, the correlations for the aggregated units will be higher than for those at the disaggregated level (Fotheringham & Wong, 1991; Wong, 2004). These inconsistent correlations imply that statistical results will vary across scales and prevent us from accurately predicting the direction of variable changes between multiple partitioning schemes. This process removes variation that occurs at the smaller level of aggregation (Wong, 2004). Openshaw and Taylor (1979) were some of the first to systematically examine analyses which include multiple boundary systems and their effect on the variability of
correlation values. To date, there is no general solution to the MAUP (Wong, 2004). It has been noted by researchers that the MAUP is generally not a hindrance to the user when creating spatial crime maps, but it can pose a problem when trying to accurately interpret data in depth (Ratcliffe, 2010).

3.3 The Current Study

Each piece of research cited within this paper are integral in developing the theoretical orientations of both social disorganization theory and routine activities theory as they are employed in current studies. Much of the current literature on the spatial and temporal patterns of violent crime rates suffer from two primary limitations. First, many of these studies avoid the integration of two theoretical orientations (e.g. Andresen and Malleson, 2015; Andresen and Malleson, 2011; Browning et al., 2010; Hipp, 2007; Peterson and Krivo, 2010; Sampson and Groves, 1989; Sampson, Raudenbush, and Earls, 1997; Weisburd et al., 2004; Weisburd, Groff, and Yang, 2012; Wikstrom et al., 2010). Second, many studies conduct a single-level analysis that examines the relationships between selected variables in one space, at one time (e.g. Groff & McEwen, 2007; Pizarro et al., 2007; Tita & Griffiths, 2005).

The current study adds to the literature in two significant ways. First, the present work integrates two major theoretical orientations to better understand spatio-temporal crime patterns within the city of Baltimore, MD. Second, Baltimore will be studied at two levels of aggregation, the block group and census tract levels, to determine whether relationships between economic and demographic factors and the dependent variable, homicide, change depending on the size of the population. This contributes to a deeper understanding of spatial and temporal patterns of homicide offending. Data spanning from 2014 to 2018 will be analyzed using software including
ArcGIS and STATA to produce valid and reliable results which can then be displayed visually using mapping technology.

3.4 Contributions to Research and Policy

This study provides a larger exploration of integrated theoretical variables’ ability to explain homicide in Baltimore, MD using a multi-level analysis. A combination of elements from the criminological theories of social disorganization and routine activities are employed to analyze the relationship that homicide has to the built environment within Baltimore, a city known for its high homicide rate within the United States. This is done to expand our understanding of the role that time and geographic location take in the course of committing severe violent crime events. By incorporating analysis at two levels of aggregation, the ability is granted to explore criminogenic patterns and trends using progressively smaller segments of geographic study areas. Focus is placed on the dynamic relationship that occurs between individuals and their built environment within two levels of distribution.

Specifically, these findings could be used to construct policies oriented on identifying markers associated with high levels of homicidal offending within large United States cities. While this study can only be generalized to Baltimore, additional research in this area can be conducted to better understand how these markers present in other metropolitan cities within the United States. The results could be used to indicate specific economic, social, and demographic factors that are associated with high levels of aggregate homicide. In the future, this model could also be applied to disaggregated homicide studies to identify key identifiers associated with individual types of homicidal offending, for example intimate partner homicide.
CHAPTER FOUR: DATA AND METHODOLOGY

4.1 Study Population & Data

Baltimore, Maryland is chosen as the primary study location based upon a few key factors. First, the historically high homicide numbers that have been recorded within the city of Baltimore indicate the city as a prime candidate for research of this variety. The city of Baltimore, MD has consistently maintained a top spot not only within the state, but also on a national level for its homicide numbers. After the death of Freddie Gray on April 27, 2015, protests and riots against police brutality broke out within the city. Distrustful relationships between the residents of Baltimore and their police force were enforced by the levels of harassment African American and Black residents experienced from Baltimore police.

Baltimore, a city with a population near 600,000 throughout the early 2000s, surpassed the homicide rates of cities with much larger populations such as New York. Since 2015, homicide numbers have reached over 300 annually, returning to the high homicide numbers experienced within the city during the 1990s.

As the population has continued to decline, the number of homicides has continued to increase demonstrating the seriousness of the violent crime problem Baltimore residents continue to face. Patterns of homicide have clustered in a variety of areas throughout the city consistently over past decades, disproportionately affecting community residents within specific neighborhoods. Baltimore is an important city to study for this reason, to both enhance our understanding of the demographic, economic, and social factors that impact the perpetration of this most serious violent crime and inform future crime prevention approaches to reduce the number of lethal criminal events.
A second key consideration when conducting this research was given to the availability of data. Baltimore’s open data portal provides the necessary information to map homicide locations and additional city features of interest accurately which helps to facilitate crime mapping efforts for spatial analysis between multiple levels of population aggregation. This data portal is updated regularly with information recorded by law enforcement and other city agencies. Information on homicides committed within Baltimore city can be downloaded per year from 2014-2018 for use in statistical analysis and crime mapping. Information on these events includes the date, time, and location of the reported incident. Additionally, information is included for the weapon used to commit the crime, the district, neighborhood, and longitude and latitude of the offense and the total number of incidents that occurred at that time in that location.

Homicide incidents are pulled for the years of interest from 2014-2018 to take a homicide count for each census tract and block group within Baltimore based on the longitude and latitude of the offense using ArcGIS. Longitude and latitude are used because they are the best location indicators when attempting to map incidents of violent crime such as homicide. Approximate addresses are generally less accurate because they do not always include the singular location of an incident. Often these approximate addresses will only indicate the block or street where a homicide is committed. Without the longitude and latitude, it would be much more difficult to map these incidents in ArcGIS. After plotting the incidents, this information can then be exported for use in two separate databases (census tract \( n = 200 \), block group \( n = 653 \)) providing an aggregated count variable that can be matched with economic and demographic variables from the American Community Survey (ACS) for Baltimore.
To include the boundaries and additional features of the landscape in Baltimore, U.S. Census TIGER files are utilized for constructing the features of Baltimore’s homicide map. TIGER files are created and maintained by the U.S. Census Bureau for use within geographic information systems (GIS). Files used within the project include city boundaries, census tract boundaries, block group boundaries, and up-to-date information on the locations of streets within the city. These files are used to create maps that can be used to calculate the homicide counts for both levels of analysis, depicted in Figure 2 and Figure 3, located in Chapter Five. Additionally, these maps can be used to provide a visual representation of the relationships that exist between homicide incidents and the independent variables of interest.

4.2 Variables

The variables incorporated in this research are constructed to measure key components of both primary theories used within the current study. Each of these variables is created for both levels of aggregation and analyzed using the same set of statistical techniques. An in-depth explanation of each variable is included in the following subsections of this chapter to provide a blueprint for other researchers to recreate each variable for use in future studies within this area of violent crime research.

4.2.1 Dependent Variable

Homicide. The dependent variable for the current study is the homicide count, taken at two levels of aggregation. Each database (census tract and block group) includes an aggregated homicide count that includes homicide incidents from January 1, 2014 through December 31, 2018. Homicide incidents and associated location data were collected from the Part 1 Crime data accessible in Baltimore’s Open Data Portal (Baltimore Open Data Portal, 2018). Homicide count
was chosen in place of using a homicide rate to ensure that census tracts and block groups with smaller populations or no population do not affect the model. Many of these census tracts (n = 24) and block groups (n = 203) have no recorded homicides for the years under analysis, therefore, using a rate based on the dependent variable would not be appropriate (Lanier & Huff-Corzine, 2006; Osgood, 2000). The definition provided from the FBI’s Uniform Crime Reports (2019) of murder and nonnegligent manslaughter was used to guide the collection of homicide data. The FBI defines murder and nonnegligent manslaughter as the “willful (nonnegligent) killing of one human being by another”.

4.2.2 Independent Variables (Social Disorganization Theory)

Disadvantage Index. A number of criminological studies conducted at the macro level have employed varying disadvantage indices to more accurately capture social inequities that influence the perpetration of violent crimes such as homicide. Some examples of these indices have included measures such as percent in poverty, percent unemployed, and percent female-headed households with one or more dependents under the age of 18 (Poole et al., 2018; Morenoff, Sampson, & Raudenbush, 2001; Sampson & Wilson, 1995; Ulmer et al., 2012; Wilson, 1987). Other measures commonly included in disadvantage indices include percent of the population 25 years and older without a high school degree or General Education Diploma (GED), median household income (reversed), and percent vacancy (Burraston et al., 2017; Krivo, Peterson, & Kuhl, 2009). The measure of disadvantaged employed in the current study includes the z-scores of five U.S. Census (2018) items including voting age poverty percent, percent female-headed households with one or more dependents under the age of 18, percent of the population 25 years and older without a high school degree or (GED), median household
income (reversed), and percent vacant households. Each variable was downloaded using the ACS data download located at census.data.gov for both the block group and census tract databases. The median household income component of the disadvantage variable for both the census tract and block group analysis was rescaled by multiplying it by (-1.00) to match the direction of the other variables in the disadvantage score.

**Geographic mobility.** The variable geographic mobility is used to address the concept of population turnover that was originally identified by Shaw and McKay as leading to elevated rates of disorganization within a community. Geographic mobility is measured by pulling information from the 2018 U.S. Census ACS 5-year estimates on the percentage of persons five and over who have moved in the last year (2014-2018). Similar measures have often been employed in studies of violent crime offending (Boessen & Hipp, 2015; Boggess & Hipp, 2010; Hipp, 2011; MacDonald et al., 2013).

**Racial and ethnic heterogeneity.** To test the impact of racial and ethnic heterogeneity on the distribution of homicide, information on race and ethnicity was pulled from the 2018 U.S. Census ACS. This was done using the census data download (data.census.gov) to ensure that all variables were representative of Baltimore census tracts and block groups. The measure utilized to capture racial and ethnic heterogeneity within the current study was originally created by P.M. Blau (1977). Racial and ethnic heterogeneity is calculated by taking one minus the squared proportions of the population in each racial and ethnic group producing a range from 0 to 1. There are six racial groups included in this heterogeneity measure, including non-Hispanic White, non-Hispanic Black, non-Hispanic Asian, non-Hispanic American Indian/Alaskan Native, non-Hispanic Native Hawaiian/Other Pacific Islander, and non-Hispanic other racial groups. The
ethnic group included in this measure is Hispanic, including any race. Blau’s index has been widely used in research conducted within the social sciences (Blau, 1977; Boesson & Hipp, 2015; Burraston et al., 2017).

4.2.3 Independent Variables (Routine Activities Theory)

Guardianship. Population density is used as a proxy for guardianship (Andresen, 2006a; 2006b). It is believed that with increases of population density, there will be an elevated number of potential guardians in an area. Using the American Community Survey (ACS) 2018 five-year estimates, population density was calculated by dividing the total population by the number of square miles within a census tract or block group. Increases in population size, on the other hand, elevate the numbers of potential targets in an area (Andresen, 2006a). It is not clear how these offsetting effects influence crime rates.

Attractive target. A few different variables are used to represent the concept of a suitable target. These include z-scored variables for four measures, including the 2018 ACS five-year estimates for population size, the number of dwellings, median dwelling value, and percent renter occupied housing (Andresen, 2006a; 2006b). Increases in the number of dwellings within an area increase the number of targets within an area, while dwelling values represent the suitability of these targets for an offender. The percentage of rental residences is thought to be related to activities drawing individuals outside of the protective environment of the home (Andresen, 2006a).

Motivated offender. The presence of a motivated offender is measured by using the percentage of the population aged 15-29 (Andresen, 2006a; Tewksbury, Mustaine, & Stengel, 2008). This age category is considered to be the best representative of primary offending age.
Information for this measure is pulled from the 5-year estimates in the 2018 United States Census.

4.2.4 Control Variable

Spatial Lag. The spatial lag variable is incorporated as a control measure to account for autocorrelation in each model with a spatial weight matrix. A spatial lag averages the neighboring values of a location and is considered a weighted average for that variable (Anselin, 2018). The spatial lag variable in this model was created using the location data for Baltimore census tracts and block groups obtained from the Baltimore Data Portal. The variable was calculated using GeoDa, a spatial statistics software. This spatial lag variable was constructed using the queen contiguity weights function instead of the rook criterion because the queen criterion is recommended to deal with potential inaccuracies in a polygon file (for example, in the shapefiles for both block groups and census tracts). This function can contend with potential rounding errors and is more widely recommended for use in practice-based projects (Anselin, 2020). The reason a spatial lag variable is included within the model as a control is to ensure that the spatial heterogeneity of homicide is accounted for in the negative binomial regression models.

4.3 Analytic Strategy

A multi-part analysis of homicide incidents is employed for use within this study. First, homicide counts are analyzed at the census tract level incorporating theoretically derived variables to test the explanatory power of social disorganization theory and routine activities theory. A second analysis at the block group level is performed to better understand how population aggregation and geographic boundaries influence the relationship between theoretical
variables of interest and homicide incidents. Each of these analyses provide a deeper understanding of the contextual factors related to homicide perpetration in Baltimore, MD.

Before running any final models, correlations are run to test for multicollinearity and depict the relationships between variables before regression analyses are employed. City nesting is controlled for within the analytic models for census tracts and block groups because block groups fall within the boundaries of census tracts. Spatial lag, a control variable is included in both analyses to account for the spatial distribution of homicide at each level of aggregation.

A negative binomial regression is used to analyze the relationship between count variables and the independent variables being analyzed (Osgood, 2000). Negative binomial regression is the preferred method of analysis when data meets the following conditions: non-normal distribution of the dependent variable and/or the variance is higher than the mean. In the current study, the data are positively skewed violating the assumptions of an OLS regression. Additionally, there is overdispersion in the data at the block group level which meets the second criteria for using a negative binomial model. Therefore, based on the poisson distribution of homicide count in Baltimore, a negative binomial regression is appropriate. A zero-inflated negative binomial regression (ZIP) was ruled out for analysis because a conventional negative binomial regression allows for overdispersion already and is easier to estimate and interpret with the data (Allison, 2012).
CHAPTER FIVE: RESULTS

5.1 Descriptive Statistics

Table 1 depicts the descriptive statistics for Baltimore census tracts for the period between 2014 and 2018. There are a total of two hundred census tracts in Baltimore, where the smallest number of homicides committed with a census tract was zero, and the greatest number of homicides committed within a census tract was thirty-four for the period under study, which is depicted in Figure 2. On average, 7.61 homicides were committed between 2014 and 2018 within a Baltimore census tract. The standard deviation shows us that per census tract, the mean could fluctuate by 0.35 homicides (less than one homicide during the five-year span).

Figure 2. Census Tracts Distribution of Homicide 2014-2018
Beginning with the disadvantage index for the first social disorganization theory independent variable, the mean score is 0.00, with a maximum of 3.10 (high disadvantage) and a minimum of -2.45 (low disadvantage) over the course of this five-year period. The disadvantage score of a census tract may differ by 1.00 on the index based on the standard deviation. At the census tract level, geographic mobility, the second independent variable, shows an average of 484.19 individuals over the five-year period have moved from one residential location to another within the past 12 months. The minimum number of individuals who moved within the past year in a single census tract was 0.00, and the maximum number of people who had moved was 2,431 which represents very high geographic mobility. The standard deviation shows that the number of people who moved per census tract may differ by 323.20 individuals. The final variable included under the social disorganization theory variable category, Blau’s Index, measures racial and ethnic heterogeneity within a census tract. The mean score for Baltimore census tracts over the five-year period was 0.66, with a standard deviation of 0.21, a maximum heterogeneity score of 0.99 (almost perfect heterogeneity), and a minimum of 0.00 (perfect homogeneity).

**Table 1.** Descriptive Statistics 2014-2018 Census Tract Homicides in Baltimore (N = 200)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homicide</td>
<td>7.61</td>
<td>0.35</td>
<td>0.00</td>
<td>34.00</td>
</tr>
<tr>
<td><strong>Independent Variables (SDT)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.00</td>
<td>1.00</td>
<td>-2.45</td>
<td>3.10</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>484.19</td>
<td>323.20</td>
<td>0.00</td>
<td>2431.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.66</td>
<td>0.21</td>
<td>0.00</td>
<td>0.99</td>
</tr>
<tr>
<td><strong>Independent Variables (RAT)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardianship</td>
<td>11633.42</td>
<td>7460.91</td>
<td>0.00</td>
<td>60910.12</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.00</td>
<td>1.00</td>
<td>-3.82</td>
<td>2.82</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>715.48</td>
<td>517.29</td>
<td>0.00</td>
<td>4597.00</td>
</tr>
<tr>
<td><strong>Control Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>7.93</td>
<td>4.64</td>
<td>0.17</td>
<td>19.38</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001
Regarding the routine activities theory independent variables of interest, we begin with the measure of guardianship. Using population density as a proxy for the concept of guardianship, we can interpret the mean of 11,633.42 as the average number of individuals living per square mile within a Baltimore census tract for the period between 2014 and 2018. The standard deviation indicates that the population density may differ by 7460.91 individuals per square mile between census tracts. The minimum score for guardianship was 0.00, with a maximum of 60,910.12 individuals per square mile within a census tract. The \( z \)-scored attractive target index representing the concept of a suitable target had a mean of 0.00, with a standard deviation of 1.00. The minimum score on the index was -3.82 (low target suitability), with a maximum score of 2.82 (high target suitability). Finally, the concept of a motivated offender was incorporated in the analysis using a proxy measure for the number of individuals aged 15 to 29 years old. The mean number of individuals in this age range per census tract was 715.48 with a standard deviation of 517.29 between census tracts. The minimum number of persons aged 15 to 29 per census tract was 0.00, with a maximum of 4,597.00 individuals.

**Table 2.** Social Disorganization Theory Correlation Matrix Census Tracks (\( N = 200 \))

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homicide Count</th>
<th>Disadvantage Index (Zscored)</th>
<th>Residential Mobility</th>
<th>Racial and Ethnic Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.6387</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>-0.0468*</td>
<td>-0.2442</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.4456</td>
<td>0.4196</td>
<td>-0.1583</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* \( p < .05 \), ** \( p < .01 \), *** \( p < .001 \)

In Table 2, bivariate correlations are shown between all social disorganization theory variables included within the current analysis on Baltimore, MD by depicting the p-values for
each variable. The disadvantage index is not significantly correlated with homicide at the census tract level. A significant negative correlation at the (0.05) level is present between geographic mobility and homicide count at the census tract level. Racial and ethnic heterogeneity is not shown to be significant with homicide count in Baltimore at this level.

Table 3. Routine Activities Theory Correlation Matrix Census Tracts (N = 200)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homicide Count</th>
<th>Guardianship</th>
<th>Attractive Target (Zscored)</th>
<th>Motivated Offender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardianship</td>
<td>0.0681</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.0391*</td>
<td>0.0342*</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>-0.0469*</td>
<td>0.1772</td>
<td>0.6249</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001
In Table 3, correlations are shown using the p-values of each variable for routine activities theory variables of interest and homicide count at the census tract level. Guardianship does not appear to have a significant correlation with homicide count at the census tract level. A significant and positive relationship at the (0.05) level is shown between the attractive target index and homicide count in Baltimore during this study period. Additionally, a significant and negative relationship is shown between the motivated offender measure and homicide count at the (0.05) level for census tracts in Baltimore.

Table 4. Descriptive Statistics 2014-2018 Block Group Homicides in Baltimore (N = 653)

<table>
<thead>
<tr>
<th>Variable</th>
<th>M</th>
<th>SD</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependent Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homicide</td>
<td>2.33</td>
<td>2.65</td>
<td>0.00</td>
<td>15.00</td>
</tr>
<tr>
<td><strong>Independent Variables (SDT)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.00</td>
<td>1.00</td>
<td>-2.80</td>
<td>3.14</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>148.30</td>
<td>163.66</td>
<td>0.00</td>
<td>2431.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.70</td>
<td>0.22</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td><strong>Independent Variables (RAT)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardianship</td>
<td>13289.51</td>
<td>9068.83</td>
<td>0.00</td>
<td>80962.11</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.00</td>
<td>1.00</td>
<td>-2.78</td>
<td>3.66</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>219.13</td>
<td>232.28</td>
<td>0.00</td>
<td>3370.00</td>
</tr>
<tr>
<td><strong>Control Variable</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>2.46</td>
<td>1.74</td>
<td>0</td>
<td>9.25</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Regarding the block group level of aggregation, Table 4 shows the descriptive statistics for all variables included in the model. There are 653 block groups within the boundaries of Baltimore City, MD. The mean number of homicide incidents occurring within a block group during the study period is 2.33 with a standard deviation of 2.65 between block groups. The minimum number of homicides that occurred within one block group is 0.00 with a maximum of 15.00 homicides occurring in a single block group between 2014 and 2018, depicted in Figure 3.
Beginning with the social disorganization theory variables, we can see that the disadvantage index has a mean of 0.00 within block groups and a standard deviation of 1.00. The minimum score on the disadvantage index is (-2.80), representing low disadvantage, and a maximum score of 3.14, which represents a high level of disadvantage. The mean number of people who have moved within the past twelve months in Baltimore block groups is 148.30, with a standard deviation of 163.66 individuals per block group. The maximum number of individuals who moved from one residential location to another per block group is 0.00, with a maximum number of 2,431.00 persons. Finally, the mean index score for racial and ethnic heterogeneity within
Baltimore block groups during the study window is 0.70 with a standard deviation of 0.22 between block groups. The maximum score is 0.00 (representing perfect homogeneity) and the maximum score is 1.00 (representing perfect heterogeneity).

Looking at the variables used to represent routine activities theory constructs at the block group level, we can see that the proxy measure for guardianship, population density, has an average of 13,289.51 individuals per square mile within a block group, with a standard deviation of 9,068.83 between block groups. The maximum population density of a block group is 80,962.11 individuals per square mile, while the minimum is 0.00 individuals per square mile in a Baltimore block group. Finally, the motivated offender measure has an average of 219.13 individuals aged 15 to 29 residing within a block group with a standard deviation of 232.28 individuals per block group. The maximum number of motivated offenders represented by those aged 15 to 29 for a single block group within Baltimore is 3,370 with a minimum number of 0.00 individuals.

Table 5. Social Disorganization Theory Correlation Matrix Block Groups (N = 653)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homicide Count</th>
<th>Disadvantage Index (Zscored)</th>
<th>Residential Mobility</th>
<th>Racial and Ethnic Heterogeneity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.4678</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>-0.0059*</td>
<td>-0.1403</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.2824</td>
<td>0.3605</td>
<td>-0.1788</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Table 5 shows the p-values for the bivariate correlations run on social disorganization theory variables and homicide count at the block group level of analysis. The disadvantage score
is not significantly correlated with homicide count at the block group level, similar to the relationship present between these variables at the census tract level. Geographic mobility is again significant and negatively related at the (0.05) level to the homicide count at the block group level. Finally, racial and ethnic heterogeneity is not shown to be related to the homicide count at the block group level of aggregation, which remains consistent with the census tract population aggregation estimates.

**Table 6. Routine Activities Theory Correlation Matrix Block Groups (N = 653)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Homicide Count</th>
<th>Guardianship</th>
<th>Attractive Target (Zscored)</th>
<th>Motivated Offender</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count</td>
<td>1.0000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardianship</td>
<td>0.0537*</td>
<td>1.0000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attractive Target</td>
<td>0.0105**</td>
<td>0.2540</td>
<td>1.0000</td>
<td></td>
</tr>
<tr>
<td>(Zscored)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>-0.0122**</td>
<td>0.3105</td>
<td>0.6031</td>
<td>1.0000</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

In Table 6 by interpreting the p-values included in the table, we can see that guardianship shows a weak positive correlation with homicide count at the (.05) level, which differs from the insignificant relationship depicted in the correlation table for these variables at the census tract level. The relationships between the attractive target measure and homicide count remains significant and positive but increases in significance to the (0.01) level. Finally, the relationship between the proxy for motivated offender and homicide count remains significant and negative, while also increasing in significance to the (0.01) level.

**5.2 Results for Negative Binomial Regression Analyses**

Negative binomial regression analyses were employed to explore the relationships that exist between the dependent variable, homicide count (2014-2018), and the theoretical variables
derived from social disorganization theory and routine activities theory constructs. The first two models for each level of analysis were run to independently examine the relationships that each of the two sets of constructs had with the dependent variable, while the final model for each aggregation level included all variables under analysis. Spatial lag was used as a control variable to account for the presence of autocorrelation between geographic units in each model.

**Table 7. Social Disorganization Theory Negative Binomial Regression**

Census Tract Homicide (N = 200)

<table>
<thead>
<tr>
<th>Homicide Count 2014-2018</th>
<th>Model 1 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.62 (0.08)***</td>
<td>1.85</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>0.00 (0.00)**</td>
<td>1.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.63 (0.27)*</td>
<td>1.88</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.06 (0.01)***</td>
<td>1.06</td>
</tr>
<tr>
<td>Constant</td>
<td>0.61 (0.23)**</td>
<td>1.83</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td></td>
<td>11.72%</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Model one can be interpreted based on the Incidence Rate Ratios (IRR) provided for the variables. It appears that for every one unit increase in the disadvantage index at the census tract level the expected mean rate of homicide count increases by 85%, given the other predictor variables in the model are held constant. Though geographic mobility has a significant and positive relationship with homicide, an imperceptible difference occurs in the homicide count for each one unit increase in geographic mobility. Regarding racial and ethnic heterogeneity, each unit increase that occurs is associated with an increase by 88% in homicide count at the census tract level if all other variables in the model are held constant.
Table 8. Routine Activities Theory Negative Binomial Regression

Census Tract Homicide (N = 200)

<table>
<thead>
<tr>
<th>Homicide Count 2014-2018</th>
<th>Model 2 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guardianship</td>
<td>0.00000402 (9.31e-06)</td>
<td>1.00</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.38 (0.10)***</td>
<td>1.46</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>-0.00 (0.00)*</td>
<td>1.00</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.15 (0.01)***</td>
<td>1.16</td>
</tr>
<tr>
<td>Constant</td>
<td>0.93 (0.21)***</td>
<td>2.54</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td></td>
<td>7.10%</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Looking at Model 2 (see Table 8), which include the variables derived from the constructs of routine activities theory, we can see that there is no association between guardianship and homicide count. A significant and positive association is shown between the attractive target index and homicide count at the census tract level at the (0.001) level of significance. By interpreting the IRR for this variable, it can be estimated that for every one unit increase in the attractive target index, a resulting 46% increase would occur in the expected mean homicide count per census tract, if all other variables in the model are held constant. Finally, though a significant and positive association is depicted for the number of motivated offenders and the mean homicide count at the census tract level of analysis, an imperceptible difference occurs in the mean homicide count as the number of motivated offenders increases (IRR=1.00).
Table 9. Social Disorganization Theory & Routine Activities Theory
Negative Binomial Regression Census Tract Homicide (N = 200)

<table>
<thead>
<tr>
<th>Homicide Count 2014-2018</th>
<th>Model 3 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.66 (0.08)***</td>
<td>1.93</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>0.00 (0.00)</td>
<td>1.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.52 (0.26)*</td>
<td>1.68</td>
</tr>
<tr>
<td>Guardianship</td>
<td>-0.0000949 (8.14e-06)</td>
<td>1.00</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.38 (0.08)***</td>
<td>1.47</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>-0.00 (0.00)</td>
<td>1.00</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.07 (0.01)***</td>
<td>1.07</td>
</tr>
<tr>
<td>Constant</td>
<td>0.99 (0.23)***</td>
<td>2.69</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td>14.01%</td>
<td></td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

In Model 3, all variables are combined to test the association between theoretically derived variables from both social disorganization theory and routine activities theory on homicide count in Baltimore at the census tract level of aggregation. Similar to the first negative binomial model, the disadvantage index and the measure of racial and ethnic heterogeneity are both positively associated with homicide count at the census tract level (IRR = 1.93 and 1.68, respectively). Finally, a positive association is shown between the attractive target index and homicide count, where for every one unit increase in the attractive target index the expected mean homicide count increases by 47% at the census tract level.

In model 4, all three social disorganization theory derived variables show a positive and significant association with homicide count at the block group level. Starting with the disadvantage index, results indicate that for every one unit increase in disadvantage at the block group level, the expected mean for homicide count increases by a factor of 1.46, holding all other
Table 10. Social Disorganization Theory Negative Binomial Regression
Block Group Homicide (N = 649)

<table>
<thead>
<tr>
<th></th>
<th>Model 4 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count 2014-2018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.38 (0.05)***</td>
<td>1.46</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>0.00 (0.00)**</td>
<td>1.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.51 (0.20)**</td>
<td>1.67</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.23 (0.03)***</td>
<td>1.25</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.42 (0.17)*</td>
<td>0.66</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td></td>
<td>9.62%</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

variables constant. Additionally, a positive relationship is depicted between geographic mobility and the homicide count at the block group level, resulting in an imperceptible difference in the mean homicide count as geographic mobility increases, holding all other variables constant.

Finally, for every one unit increase in the racial and ethnic heterogeneity index, the expected mean homicide count increases by a factor of 1.67, holding all other variables constant.

Table 11. Routine Activities Theory Negative Binomial Regression
Block Group Homicide (N = 653)

<table>
<thead>
<tr>
<th></th>
<th>Model 5 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homicide Count 2014-2018</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guardianship</td>
<td>-0.00000032 (5.19e-06)</td>
<td>1.00</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.21 (0.06)***</td>
<td>1.24</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>-0.00000246 (0.003)</td>
<td>1.00</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.39 (0.03)***</td>
<td>1.48</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.27 (0.12)*</td>
<td>0.77</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td></td>
<td>7.71%</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Model 5 shows the association between homicide count and theoretically derived variables coming from routine activities theory constructs at the block group level in Baltimore, MD. The only significant association that occurs within this model is a positive association
between the attractive target index and homicide count. It seems that for every one unit increase in the attractive target index, an expected increase of 24% occurs in the mean homicide count at the block group level.

**Table 12. Social Disorganization Theory & Routine Activities Theory**

**Negative Binomial Regression Block Group Homicide (N = 649)**

<table>
<thead>
<tr>
<th>Homicide Count 2014-2018</th>
<th>Model 6 Coefficients (SE)</th>
<th>IRR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disadvantage Index (Zscored)</td>
<td>0.41 (0.05)**</td>
<td>1.51</td>
</tr>
<tr>
<td>Geographic Mobility</td>
<td>-0.00 (0.00)</td>
<td>1.00</td>
</tr>
<tr>
<td>Racial and Ethnic Heterogeneity</td>
<td>0.57 (0.19)**</td>
<td>1.77</td>
</tr>
<tr>
<td>Guardianship</td>
<td>-9.18e-06 (5.07e-06)</td>
<td>1.00</td>
</tr>
<tr>
<td>Attractive Target (Zscored)</td>
<td>0.28 (0.05)**</td>
<td>1.32</td>
</tr>
<tr>
<td>Motivated Offender</td>
<td>0.00 (0.00)</td>
<td>1.00</td>
</tr>
<tr>
<td>Spatial Lag</td>
<td>0.25 (0.03)**</td>
<td>1.29</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.32 (0.17)</td>
<td>0.73</td>
</tr>
<tr>
<td>Pseudo R²</td>
<td></td>
<td>10.87%</td>
</tr>
</tbody>
</table>

* p< .05, ** p< .01, *** p< .001

Finally, Model 6 incorporates all variables in Model 6 at the block group level. Three associations between variables of interest and the homicide count emerge. The first positive association can be seen between the disadvantage index and homicide count, where for every one unit increase in the disadvantage index, a resulting 51% increase in the expected mean homicide count occurs within the block group. The second positive association occurs between racial and ethnic heterogeneity and homicide count, showing that for every one unit increase in racial and ethnic heterogeneity, a resulting 77% increase occurs in the expected mean homicide count. Finally, the attractive target index has a positive association with the homicide count at the block group level where for every one unit increase in the attractive target index occurs, a resulting 32% increase occurs in the expected mean homicide count, holding all other variables constant in the model.
CHAPTER SIX: DISCUSSION & CONCLUSION

6.1 Discussion

This study tests whether constructs taken from two influential criminological theories, social disorganization theory and routine activities theory, have the ability to explain variation in aggregate homicidal offending for a five-year period, spanning 2014-2018, within Baltimore City, MD. Research has been conducted on understanding homicide using constructs coming from each of the two theories, but there has been little research attempting to combine the major theoretical aspects of both in a singular study examining homicide at two levels of aggregation. The current study finds that core constructs from these major theoretical orientations offer some explanatory power at both levels of aggregation, specifically at the census tract and block group levels. The results show very similar relationships depicted between the dependent variable, homicide count, and the independent variables under analysis at both the block group and census tract levels. There are a few major findings that could be taken from the results, which will be discussed in depth below.

6.2 Major Findings

At the census tract level of analysis, all social disorganization theory variables showed to be statistically significant in explaining some variation of aggregate homicide in the stand-alone model. Each of these relationships had a positive association with the homicide count. Specifically, the model predicts that as the disadvantage score increases, so too will homicide count within Baltimore census tracts. Similar positive associations are shown for both geographic mobility and racial and ethnic heterogeneity.
Additionally, when examining the relationships between routine activities theory derived variables in the second negative binomial model, all variables showed to have significant associations with the homicide count. One of these relationships was positive in nature, specifically between the attractive target measure and homicide count, meaning that as the levels of population size, the number of dwellings, median dwelling value, and percent renter occupied housing increase, so too does homicide count for census tracts in Baltimore. Finally, the model shows a negative association between the motivated offender measure and homicide count. This finding is interesting, because intuitively, it would make more sense that as the number of motivated offenders (individuals aged 15-29) increased, one might infer that the number of individuals engaging in acts of violence leading to lethal outcomes might also increase, instead of decrease.

When examining the combined theoretical model at the census tract level, three significant associations stand out. First, a positive and significant association is shown between the disadvantage index and homicide count, further supporting the results of the original social disorganization theory-based model. Second, a moderately significant and positive association is revealed between racial and ethnic heterogeneity and homicide count, again supporting the earlier relationship shown between the two variables. Finally, the association between the attractive target measure and homicide count continues to be significant and positive in the combined model at the census tract level. Interestingly to note is the change in significance between homicide count and the variables representing geographic mobility as a social disorganization-based measure, and the motivated offender as a routine activities based measure.
It is also important to note that the explanatory power of the model increased when combining all theoretical measures within the same analysis of homicide count at the census tract level.

Regarding the block group level of analysis, we first begin with discussing the stand-alone social disorganization theory based negative binomial regression model. Similar to the census tract model, we can see that all social disorganization theory-based constructs are statistically significant and hold positive associations with homicide count at the block group level. In the routine activities theory-based model, there is one distinct difference shown in the relationships between homicide count and the independent variables of interest. In the census tract model, two of three variables showed statistically significant associations with homicide count. In the block group model, only one variable, the attractive target index, has a significant association with homicide count. The association between the variable representing the number of motivated offenders and the homicide count change between the census tract and block group levels from a significant and negative association to an insignificant association. This may result from the population change between geographic units, but frankly this is speculation. More testing may help reveal why these inconsistencies occur between levels of aggregation.

In the combined theoretical model for the block group level, the same three variables hold significant and positive associations with homicide count as in the combined census tract model. Again, the model indicates that as the disadvantage index, measure of racial and ethnic heterogeneity, and the attractive target index increase in value, so should the homicide count at the block group level of aggregation.
6.3 Limitations & Future Research

Though this study has contributed to our understanding of the theoretical applications of social disorganization and routine activities theory in explaining aggregate homicide at both the census tract and block group levels of analysis, there are many questions left to be answered. In a study such as this, limitations are inherent to the study design. One such limitation stems from the use of an aggregate homicide count. In future research, it would be beneficial to disaggregate homicide counts by type, for example intimate partner homicide, familicide, etc., to better understand the explanatory abilities of theoretical components stemming from both social disorganization and routine activities theory regarding various types of homicidal offending (Parker, 2001; Ousey & Kubrin, 2014). After all, independent variables may differentially impact varying categories of homicide.

Additionally, while this study examined both census tract and block group aggregation levels, future research should endeavor to examine even finer levels of aggregation such as the street segment level in order to better understand situational factors that may influence homicidal offending with available data. Finally, this analysis was limited to the study of one city, Baltimore, MD, limiting the generalizability of findings. It would be more impactful to conduct this study over multiple cities at two or more levels of aggregation to see if similar relationships between homicide count and the theoretical variables of interest occur consistently or differ between geographic locations.

6.4 Conclusion

In conclusion, this work has contributed to our understanding of how two prominent criminological theories can be applied to study aggregate levels of homicide at various
population aggregations. The findings of this research build upon ecological studies of homicide utilizing the foundations of both social disorganization theory and routine activities theory. The research conducted has provided additional support for the notion that theoretically derived variables stemming from both social disorganization theory and routine activities theory are associated with homicide counts at varying levels of population aggregation in one large city within the United States. Additional research in the future should test these association at both larger and smaller levels of aggregation to depict any changes in the anticipated relationships of these variables. Additionally, future research would benefit by dividing homicide into categories based on motivation to uncover more nuanced details regarding the associations between these theoretical measures and multiple homicide types.

The findings of this research are important because they show that differing levels of population aggregation impact the expression of associated measures with the homicide count. Additionally, changes in the nature of these relationships reveal that shifts in population aggregation may impact the ways in which homicide counts increase or decrease depending on the geographic area under study. It would be interesting to compare these results with other cities to better understand if these associations are consistent across a variety of geographies or if they differ based on location throughout the United States. Overall, the present research has contributed not only to the theoretical study of homicide, but also to the geospatial study of homicide incidents in large American cities as well.
NOT HUMAN RESEARCH DETERMINATION

May 31, 2022

Dear Kayla Toohy:

On 5/31/2022, the IRB reviewed the following protocol:

<table>
<thead>
<tr>
<th>Type of Review</th>
<th>Initial Study</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title of Study</td>
<td>Homicide Patterns in Urban Places: A Geospatial Analysis of Homicide in Baltimore, MD</td>
</tr>
<tr>
<td>Investigator</td>
<td>Kayla Toohy</td>
</tr>
<tr>
<td>IRB ID</td>
<td>STUDY00004171</td>
</tr>
<tr>
<td>Funding</td>
<td>None</td>
</tr>
<tr>
<td>Grant ID</td>
<td>None</td>
</tr>
<tr>
<td>Documents Reviewed</td>
<td>• HRP251_IRBForms_ToohyDissertation (1).pdf, Category: Faculty Research Approval;</td>
</tr>
<tr>
<td></td>
<td>• Data Dictionary Huron IRB.docx, Category: Other;</td>
</tr>
<tr>
<td></td>
<td>• HRP-250-FORM- Request for NHSR.docx, Category: IRB Protocol;</td>
</tr>
</tbody>
</table>

The IRB determined that the proposed activity is not research involving human subjects as defined by DHHS and FDA regulations.

IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities are research involving human in which the organization is engaged, please submit a new request to the IRB for a determination. You can create a modification by clicking **Create Modification / CR** within the study.

If you have any questions, please contact the UCF IRB at 407-823-2901 or irb@ucf.edu. Please include your project title and IRB number in all correspondence with this office.

Sincerely,

Kamille Birkbeck

Kamille Birkbeck
Designated Reviewer
REFERENCES


79


