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A Walk in the Park: A Spatial Analysis of Crime and Portland Parks

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by

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Abstract

This thesis presents two individual research papers that examine the relationship between greenspaces and crime in Portland, Oregon. The two papers use an adapted street network buffer to better measure crime concentration around discrete locations. This methodological development allows for an improved measure of crime concentration around discrete locations.

The first contribution, presented in Chapter 2, explores the relationship between different greenspace types and crime, breaking down different crime types into discrete categories. The results of this study suggest that overall, Portland greenspaces do not experience a concentration of crime, however, different patterns emerge as greenspace and crime types are disaggregated. Only one greenspace type, small parks, appear to be important local features—experiencing a high concentration of crime—while other types experienced a concentration of a few crime types, or none at all.

Building off of these results, the second contribution—Chapter 3—examines the relationship between small parks and crime in more detail, looking at the level of crime concentration beyond the park, the presence of certain amenities, and the surrounding land-use zoning. A non-linear pattern in the level of crime concentration was found in the 3-block area around parks. Three park characteristics (statues/public art, water features/fountains, and plazas) were found to be associated with higher levels of crime at parks, while one characteristic (unpaved paths) and two activity generators (soccer fields and softball fields) were associated with lower levels of crime. The surrounding zoning also had an impact on crime at parks, with parks with exclusively or majority residential land use experiencing lower levels of crime.

Together, the results of these studies suggest that small parks should be the focus of crime prevention strategies undertaken by the city of Portland. Further, the results highlight the importance of disaggregating crime and location types to better understand the complex relationship between the two. These findings have important implications for the city of Portland and its greenspaces, as well as future research examining the relationship between this location type and crime.

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Dedication

This is dedicated to my advisor, Dr. Wuschke. Thank you for all of your support, I couldn't have done this without you.

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Chapter 1: Introduction

Introduction

The field of environmental criminology has always emphasized the importance of examining *where* crime occurs. Theories including social disorganization theory, routine activity theory, and crime pattern theory all focus on explaining why crime occurs where it does. This is often achieved by examining the relationship between crime and different types of places. Places refer to a discrete location and can include street segments or specific buildings/facilities (e.g., bars). One place type, the urban greenspace, has received attention in the past decade, as scholars have attempted to explain the relationship between these locations and crime (Boessen & Hipp, 2018; Breetzke et al., 2020; Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017; Taylor et al., 2019).

Research on greenspaces highlight their importance in the urban landscape. They provide much needed outside space for residents, supporting individuals' mental and physical health, improving residents' sense of community and strengthening social cohesion (Yang et al., 2005; Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Taylor et al., 2019). While these benefits are well-supported in the literature, criminological theories conflict when examining the role of greenspaces in preventing or promoting criminal activity (Boessen & Hipp, 2018; Groff & McCord, 2011). Thus, the relationship between greenspaces and crime is uncertain as some studies find that there is a higher concentration of crime at and near greenspaces (Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017; Taylor et al., 2019), while other studies indicate that

crime does not concentrate in these locations (Boessen & Hipp, 2018; Breetzke et al., 2020).

The current research builds on these studies, by examining the greenspace-crime relationship in Portland, Oregon. This thesis presents two original research papers that expand on current greenspace and crime literature by examining the concentration of crime at and around these locales. The two papers presented in this thesis improve upon the methods of prior studies in three ways: by using a modified street-buffer approach to measure crime concentration in a way that reduces rate inflation by better excluding areas where events are unlikely to occur or be reported; by disaggregating crime types to determine whether specific crimes may concentrate at and near greenspaces differently; and by disaggregating greenspace types to determine whether the patterns of crime concentration are consistent for greenspaces with different uses (e.g., park, community garden). The first paper addresses the question of whether there is a relationship between crime and greenspace in Portland, examining different greenspace types (e.g., parks, community gardens) and different crime types (e.g., simple assault, robbery). The second paper builds upon the findings of the first, narrowing the focus to small parks, and examining crime concentration as well as the effect of park amenities (e.g., sports fields) and surrounding land use (e.g., residential).

Theoretical Framework

The research presented in this thesis is grounded within the field of environmental criminology. The origins of environmental criminology date back to the 19th century with the work of Adriano Balbi and André-Michel Guerry (1829) as well as Adolphe Quetelet

(1831) which highlighted the clear relationship between geography and crime (Andresen, 2014; Balbi & Guerry, 1829; Quetelet, 1831). Subsequent research examining the spatial patterns of crime have confirmed what these researchers found roughly 200 years ago: that crime does not occur randomly in space and time (Andresen et al., 2017; Sherman et al., 1989; Weisburd et al., 2004). Thus, the field of environmental criminology focuses on the *where* of crime, acknowledging the importance of place as it relates to the occurrence of criminal incidents. This relationship was (and still is) clearly documented in criminological research, so the question has become: *why* do some areas experience more crime than others? Several key theories have been developed in an attempt to explain this relationship, including social disorganization theory (Shaw & McKay, 1942), routine activity theory (Cohen & Felson, 1979), rational choice theory (Cornish & Clarke, 1987), the geometric theory of crime, and crime pattern theory (Brantingham & Brantingham, 1993; Brantingham & Brantingham, 1995).

Social Disorganization Theory. In *Juvenile Delinquency and Urban Areas (1942),* Shaw and McKay set out to examine whether neighborhood (physical, economic, and population) characteristics were correlated with delinquency (Shaw & McKay, 1942). Central to this theory is that neighborhoods can be classified along a spectrum, ranging from socially organized to socially disorganized (Kubrin, 2009). The assumption is that disadvantageous neighborhood conditions (specifically low economic status, ethnic heterogeneity, and residential mobility) lead to disorganization within the neighborhood and that high social disorganization facilitates crime and delinquency (Shaw & McKay, 1942; Shen and Andresen, 2021). The underlying assumptions of social disorganization theory (SDT) are that these characteristics act as a barrier to social cohesion and make

informal social control hard to develop, due to high population turnover and language and cultural barriers, in the case of ethnic heterogeneity (Shaw & McKay, 1942; Shen and Andresen, 2021). When neighborhoods lack this control and cohesion, residents are less willing to confront potential offenders, which leads to more crime (Hipp, 2010).

Shaw and McKay found support for SDT, with poverty showing the strongest relationship with crime (Shaw and McKay, 1942). In 1989, Sampson and Grove conducted one of the first empirical tests of SDT, proposing an extended model by adding family disruption and urbanization as sources of social disorganization (Sampson & Grove, 1989). The results of this study supported SDT, finding a relationship between the structural factors explained by social disorganization and criminal offending and victimization (Sampson & Grove, 1989). Other studies have confirmed this relationship, finding positive relationships between crime and residential instability, racial or ethnic heterogeneity, and poverty or low economic status (Cahill & Mulligan 2003; Hipp, 2007; McNulty & Holloway, 2000; Roncek & Maier, 1991; Sampson and Groves 1989; Warner & Rountree, 1997;).

Routine Activity Theory. Originally proposed by Cohen and Felson (1979), routine activity theory has grown to be a predominate theory within environmental criminology. In the article, *"Social Change and Crime Rate Trends: A Routine Activity Approach,"* Cohen and Felson questioned why crime had risen despite an improvement in many of the societal factors (e.g., education, employment) previously thought to cause crime (Cohen & Felson, 1979). They argued that since World War II, the United States had experienced a shift in peoples' routine activities that had led to more opportunities for criminal victimization. In addition to this, technological advancements had made potential

targets (e.g., televisions) more portable and valuable. The combination of these two occurrences increased the probability that a motivated offender and suitable target would converge in the absence of a capable guardian (Cohen & Felson, 1979). According to this theory, these three elements had to converge in both space and time for a crime to occur (Cohen & Felson, 1979). In this way, the routine activity approach emphasized the spatial-temporal aspect of the criminal event rather than focusing on the motivations of the offender.

Rational Choice Theory. In 1987, Cornish and Clarke proposed the rational choice theory, which assumes that offenders engage in criminal behavior to benefit themselves. This involves making decisions and choices based on rationality, albeit constrained by the offender's cognitive abilities, time, and information available (Cornish & Clarke, 1987). Essentially, this means that the potential offender decides whether or not to commit a crime based on a personal assessment of the perceived benefits and risks of the action. At the first stage, an individual's motivation itself is defined as a series of rational choices which answer the question: if given the opportunity to commit a crime, would I? This fulfills the motivated offender requirement of routine activity theory. A second stage of decision making arises once an opportunity is presented, where the decision is based partly on the environment. Thus, rational choice theory simplifies the criminal offense into a series of predictable decisions made by a motivated offender, based on the perceived risks and benefits, as well as the opportunities present at a specific space and time.

Geometry of Crime. The Brantingham's geometry of crime approach (1981) investigates how the spatial/temporal dimension of a criminal event interacts with the other three dimensions: a target, offender, and law (Andresen, 2014). In understanding this

theory, it is important to understand the complex environment within which criminal events occur. The Brantinghams introduce several concepts, including the environmental backcloth, pathways, nodes, edges, activity space, and awareness space (Brantingham & Brantingham, 1993). The first four focus specifically on the built environment, while the latter two relate to the perspective of people (both potential offenders and victims). The environmental backcloth refers to the context of place, both long and short term. For example, this considers short term context changes such as the time of day (e.g., day vs. night) as well as long term context changes such as gentrification. Pathways refer to space that we use to move through the built environment and can be anything from a road or railway system to a sidewalk or trail. Nodes refer to places where people spend time (rather than moving through) and can be thought of as any discrete location (e.g., a shopping center). Edges refer to boundaries, both physical and perceptual (i.e., social) and examples include bodies of water or changes in land use. The pathways and nodes that are frequented by an individual, during the course of their routine activities, make up their activity space. The activity space and its surrounding areas make up the awareness space, both referring to the areas in which an individual spends a lot of their time and are familiar with (Brantingham & Brantingham, 1993).

According to the geometry of crime, a motivated offender receives good or bad cues from the environment when identifying suitable targets. These cues form a crime template—a checklist of items or circumstances that must be present or absent in order for the offender to choose to commit a crime (Andresen, 2014; Brantingham & Brantingham, 1993). Rational choice theory comes into play here as the assumption is that the potential offender is making rational decisions based on the environment and how well it satisfies

the crime template. Like everyone else, offenders exist within their activity and awareness spaces and, as such, these are the areas in which they are more likely to identify a target and commit a crime. This rests on the assumption that a motivated offender is unlikely to travel too far to commit a crime, due to the increased cost and effort, termed as "distance decay" (Andresen, 2014). When specific pathways and nodes are a part of many individuals' activity spaces, these locations may experience more crime because they offer more opportunities for motivated offenders to identify suitable targets. Examples include shopping malls, which will form part of many peoples' activity spaces and offer a number of suitable targets (e.g., goods for sale, people shopping). There are two terms for these types of places: crime generators and crime attractors. The former refers to nodes that attract a large number of people for non-criminogenic reasons (as in the example of a shopping mall), increasing the number of potential targets and offenders, generating more crime. The latter refers to a node that is known to be suitable for a specific type of crime which attracts motivated offenders for that purpose (Brantingham & Brantingham, 1995).

Crime Pattern Theory. In 1993, the Brantinghams proposed crime pattern theory as a meta-theory, combining aspects of routine activity theory, the geometry of crime, and rational choice theory to explain the criminal event (Brantingham & Brantingham, 1993). In its simplest form, pattern theory asserts that the criminal event occurs as the result of a triggering event through a broad or minimal search for the opportunity for crime. The triggering event simply refers to *something* that happens that results in the motivation to commit a crime (e.g., seeing a laptop left alone). This triggering event is the result of the individual's current actions as well as their crime template, as the triggering event occurs through the course of their actions and can only be identified if it satisfies the conditions

of the template. The crime template and current actions are both influenced by the routine activities of the individual, which define the activity and awareness spaces (i.e., where a motivated offender is most likely to *want* to commit a crime). Finally, these routine activities are shaped by the environmental backcloth—including the structural (e.g., built environment), social, economic, and legal backcloths (Andresen, 2014; Brantingham & Brantingham, 1993).

Hot Spots and Risky Facilities. In their 1989 study of predatory crime, Sherman and colleagues noted that crime occurs at a specific time and place. They recognized the importance of routine activity theory as it relates to places, arguing that the implied premise of routine activity theory was that crime is not random (Sherman et al., 1989). In their study, they tested these assumptions using police call data, finding that 50.4% of all calls came from 3.3% of places; the authors termed these locations hot spots (Sherman et al., 1989). This idea of crime "hot spots" has found tremendous support in criminological literature, with certain types of places found to be more criminogenic, the explanation being rooted in the theories presented above (Andresen et al., 2017; Bernasco & Block, 2011; Drawve & Barnum, 2018; Hart & Miethe, 2014; Weisburd et al., 2004).

In addition to crime being concentrated geographically, Eck and colleagues noted that even within different place types (e.g., different types of bars), research generally finds that a small proportion of locations accounts for the majority of crime, terming these places "risky facilities" (Eck et al., 2007). Research at the place/facility level is often considered the study of crime and place (Wilcox & Cullen, 2018). In addition to examining the concentration or clustering of crime, these studies also examine what factors drive this relationship, focusing on what place types are criminogenic (Bernasco & Block, 2011;

Drawve & Barnum, 2018; Hart & Miethe, 2014; Wuschke & Kinney, 2018), what features present at a place seem to be criminogenic (Groff & McCord, 2011; McCord & Houser, 2017), and what features may be protective, such as CCTV, guardianship, and other crime prevention tactics (Eck & Guerette, 2012; Piza et al., 2014; Reynald, 2009; Reynald, 2011; Wilcox & Cullen, 2018).

Taken together, these theories and concepts offer a number of explanations for the causes of crime at specific location types. They emphasize the importance of understanding the crime-place relationship as it relates to the opportunities for crime to occur and, as such, help to explain why some areas experience more crime than others.

Greenspace, Parks, and Crime

It is well recognized that urban greenspaces provide greatly needed health and social benefits to city dwellers (Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Yang et al., 2005). Despite this, criminological theories conflict when examining the role of greenspaces in preventing or promoting crime. On the one hand, routine activity theory would suggest that a well-used greenspace has increased levels of guardianship which would lead to reduced levels of crime. On the other hand, the presence of a lot of people would increase the number of targets (i.e., the people and their belongings), thereby acting as a crime generator (with more opportunities for crime), leading to increased levels of crime. Further, a neglected greenspace could act as a crime attractor, known to be a good space (e.g., due to the lack of guardianship or secluded areas) to commit specific crimes.

In the past decade, multiple studies have examined the complex relationship between greenspaces and crime, incorporating key elements from social disorganization

theory, routine activity theory, and crime pattern theory (Boessen & Hipp, 2018; Breetzke et al., 2020; Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017). The seminal work in this area of study, that of Groff and McCord, examined the relationship between crime and small neighborhood parks in Philadelphia (Groff & McCord, 2011). Emphasizing the lack of research examining this relationship, Groff and McCord set out to answer the question: are parks associated with higher levels of crime in adjacent areas? They hypothesized that parks would act as crime generators, that crime would decrease as distance to the park increased, that there would be a positive relationship between recreational amenities and crime, and that crime would be higher in parks surrounded by mixed (residential and non-residential) land use (Groff & McCord, 2011). Groff and McCord used 50ft Euclidean buffers around each park as the "park environ," which served both a practical and theoretical purpose. First, the crime data did not allow for a distinction between crimes that happened in and outside of the park. Second, according to crime pattern theory, the streets adjacent to the park form part of the situational backcloth and are therefore relevant to the park itself (Groff & McCord, 2011). Using location quotients as a measure of crime concentration and statistically comparing the clustering of crime at parks to random city intersections, Groff and McCord found that crime did cluster in and around parks. Specifically, they examined violent, property, and disorder crime, finding all to be twice as concentrated compared to the rest of the city (Groff & McCord, 2011). They also found that there was a nonlinear relationship between distance to the park and crime, with crime concentrating less when moving one block away (400ft) but increasing again at the second block (800ft). Testing amenities and park features, they found that generally sports amenities (e.g., basketball courts), lighting, and the presence of public transit were

protective, while evidence of park adoption (e.g., signage/rules) was associated with higher property crime rates (Groff & McCord, 2011). Lastly, examining surrounding land use, they found that parks with non-residential land use had the lowest crime concentration.

Building on the work done in the Groff and McCord study, McCord and Houser replicated the study in Louisville, Kentucky to compare with the findings from Philadelphia (McCord & Houser, 2017). Using the same methods, this study confirmed the findings of Groff and McCord: that crime was more clustered around parks. They found that all three crime types (violent, property, and disorder) were more than twice as concentrated around the parks in Louisville. Looking outwards at the surrounding blocks, they found that violent and disorder crime decreased when moving away from the park, but property crime experienced the same nonlinear relationship as seen in Philadelphia (McCord & Houser, 2017). Examining park characteristics, they found that the presence of benches was associated with lower levels of violent crime, while public transit was associated with increased crime. Parking lots and evidence of park adoption were associated with lower property crime, while benches and improved walkways were associated with lower disorder crime and basketball courts and public transit were associated with higher disorder crime (McCord & Houser, 2017).

There have since been several other studies that examine the relationship between parks—or other greenspaces—and crime, each of which have employed varied methods. Building on the work of Groff and McCord, Taylor and colleagues (2019) examined the relationship between parks and crime in Philadelphia, addressing a key limitation of the 2011 study: neighborhood context (Taylor et al., 2019). This study incorporated park characteristics (e.g., amenities or crime prevention efforts) as well as several neighborhood

characteristics: social cohesion, socio-economic status, residential instability, immigration/foreign born (index), the percent of the population that were young males 15-24, and racial and ethnic heterogeneity (Taylor et al., 2019). Looking at violent and disorder crime, they found that social cohesion was significantly linked to disorder crime, while the level of violent crime at parks was related to the level of violent crime outside of parks (but nearby) and the presence of security fencing (Taylor et al., 2019). Using similar methods to Groff and McCord (2011), Breetzke and colleagues examined the relationship between gun violence and greenspaces in Detroit. Using greenspaces and three buffers at 100-meter intervals, they tested this relationship, finding gun violence to be substantially less concentrated in greenspaces compared to the rest of the city (Breetzke et al., 2020).

In 2017, Kimpton and colleagues set out to examine the relationship between greenspace and crime in Queensland, Australia. This study considered four factors: (1) greenspace type, (2) temporal patterns of greenspace crime, (3) neighborhood social composition, and (4) the presence of neighborhood crime generators (Kimpton et al., 2017). The authors considered the type and number of amenities present at greenspaces, the size of the greenspace, and the presence of nearby transit stops, and employed a cluster analysis to classify greenspaces into four clusters: amenity rich, sit or play, transport, or amenity poor (Kimpton et al., 2017). Testing the effect of greenspace type, they found that public nuisance crime occurred disproportionately within sit or play and transport greenspace types, while property damage crime occurred within both amenity rich and amenity poor greenspace types. Looking at the timing of crime at greenspaces, they found that daily and weekly timing varied by greenspace type, although this relationship differed for different crime types. They found that three specific social context variables related to

greenspace crime: an increase in neighborhood adolescents was associated with reductions of public nuisance crime; an increase in ranked diversity was associated with reductions of property theft; and an increase in ranked disadvantage was associated with higher levels of violence, theft, public nuisance crimes, and property damage crime. Lastly, they found that the presence of schools and licensed venues was associated with increased crime, which varied by crime type (Kimpton et al., 2017).

In 2018, Boessen and Hipp took a broader approach, examining the role of parks as they relate to community crime, testing whether the neighborhood demographics and land use moderate the relationship between parks and crime (Boessen & Hipp, 2018). This study examined nine cities: Chicago, Cleveland, Columbus, Dallas, Los Angeles, Milwaukee, Oakland, San Francisco, and Tucson and focused on six crime types: aggravated assault, robbery, homicide, burglary, motor vehicle theft, and larceny. They used several independent and control measures, including the proportion of each census block containing parkland, the size of the park, land use measures (residential, retail, industrial, office space, and other), concentrated disadvantage, percent homeowners, percent Latino, and percent aged 16 to 29 (Boessen & Hipp, 2018). Their results suggested that there were few differences in crime amounts for blocks with parks compared to other blocks. They found that blocks with parks had more crime than residential areas, but less that commercial and office areas. As it relates to industrial areas, parks had less property crime but more violent crime. Examining crime near parks, they found that blocks close to parks (within 400ft) had lower crime rates than other blocks, controlling for other variables. Interestingly, they found that residential areas close to parks had higher crime rates compared to residential areas not near parks. They also found the percent of Latinos,

percent of 16- to 29-year-olds, and increased concentrated disadvantage were all associated with higher crime rates, although these patterns varied by crime type (Boessen & Hipp, 2018).

Gaps in the Literature

These studies have greatly improved our understanding of the relationship between greenspaces and crime by examining this relationship in various cities, using varying methods, and testing the impact of features—both inside the park and externally. Despite this, shortcomings remain, specifically regarding spatial methods in measuring concentration, generalizability to other cities and locations, and understanding the important varying patterns of different crime types as well as different greenspace types (Andresen & Linning 2012; Wuschke & Kinney, 2018).

Concerning the spatial methods used, studies examining the location quotient require two separate areas to calculate the concentration of crime: the area of interest ("environs") and the study area (i.e., the rest of the city). These studies have typically used Euclidean buffers, or straight-line distances surrounding an area of interest to form the environ, and the overall city area to represent the study site. This is inherently limiting as it captures areas where crimes are unlikely to occur (e.g., cliffs/water) as well as areas where crimes are typically not recorded to within police data (which often place events along the road network, or slightly offset of the road itself). Capturing these areas leads to inaccuracies with the rate-based measures by falsely inflating the denominator, resulting in a lower rate. This is particularly important in measures that rely on rate ratios, such as the location quotient. A low rate in the overall study area can result in even small crime

counts within the environ areas to be flagged as meaningful concentrations. In a recent study, Wuschke and colleagues presented a modified version of the location quotient, using the street network distance which reduced the problem discussed above (Wuschke et al., 2021a). This method, however, relies on address-level crime data—which is often not available within public crime records. Thus, future adaptions in the methods used to measure crime concentration are necessary as crime data becomes more publicly available (Wuschke et al., 2021b).

Regarding generalizability, the results of the prior studies on greenspace and crime are inconsistent, with some finding that greenspaces have a higher concentration of crime (Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017; Taylor et al., 2019), and others finding that they do not (Boessen & Hipp, 2018; Breetzke et al., 2020). Studies have also found differences in the park characteristics, such as features or surrounding land use, that are associated with crime (Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017). More research is needed to examine the relationship between greenspaces and crime in different locations, as well as the impact of amenities and surrounding characteristics.

Concerning the aggregation of crime types, Andresen and Linning (2012) argue that this is generally not appropriate. They argue that because opportunities for different crime types differ, so do the spatial patterns of their occurrence (Andresen & Linning, 2012). Prior park studies have typically used aggregated crime data, focusing on groupings such as violent, property, and disorder crime. The exceptions to this are Breetzke and colleague's study, which examined one specific crime type (gun violence), and Boessen and Hipp's study, which did not use location quotients. Thus, disaggregating crime types

is an important step in improving our understanding of the relationship between greenspaces and crime.

Additionally, although studies on greenspaces and crime have examined various categories of this land use, including greenspaces as a whole (Breetzke et al., 2020; Kimpton et al., 2017) as well as smaller neighborhood parks (Boessen & Hipp, 2018; Groff & McCord, 2011; McCord & Houser, 2017; Taylor et al., 2019), they have yet to do so in the same study location. In their 2018 study, Wuschke and Kinney found that there was a lack of uniformity in the concentration of crime around different place categories once broken down into more discrete land use types (Wuschke & Kinney, 2018). This highlights the importance disaggregating place types and suggests that the concentration of crime may vary based on the greenspace type, something that has not been well studied.

Current Research

Seeking to build on prior studies and address the gaps in the literature, this thesis presents two research papers that examine the relationship between greenspaces and crime in Portland, Oregon. Both of these seek to add to the literature and test the generalizability of past findings, while addressing the limitations discussed above. Both papers apply an improved measure of area in the calculation of location quotients, using a modified street buffer and environ, which allows the exclusion of area where crime is (1) not likely to occur and (2) not recorded by the Portland Police Bureau. This allows for a more accurate measure of the concentration of crime. Additionally, both papers disaggregate crime types to examine how different crimes (which rely on different opportunities) may concentrate differently around greenspaces. The first paper focuses on different types of greenspaces

and attempts to test the variability of crime concentration around these different types. The second paper builds upon the results of the first, focusing on greenspaces found to be most locally relevant.

The thesis follows a multi-paper format. This chapter has provided an overview of the theoretical background of the study, including a review of prior research relating to greenspaces and crime. Following, chapter 2 presents the first research paper, which focuses on greenspaces and crime in Portland. Chapter 3 presents the second research paper, which takes a closer look at small parks and crime and considers the park characteristics as well as surrounding land use. Finally, chapter 4 summarizes the key findings of the research as well as the implications and future directions.

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Chapter 2: Manuscript One – A Spatial Analysis of Greenspace and Crime in Portland, OR.

Abstract

Greenspaces play an important role in the urban landscape, with past research suggesting that they are associated with numerous health and social benefits for residents. Despite this, research on the relationship between greenspaces and crime conflicts, with some studies finding these locations to be criminogenic while others find them to be protective against local crime. This study examines this relationship in Portland, Oregon, considering different greenspace types as well as different crime types. Further, this study presents a novel methodological adaption to measure crime concentration around discrete location types by using a street network buffer. Overall, the results suggest that Portland's greenspaces, as a whole, do not experience a concentration of crime, however, varying patterns emerge when examining different greenspace and crime types. This study identified diverse crime concentrations in proximity to small parks, while other greenspace categories appear to be associated with nearby crime-specific concentrations. Others, still, seem to have lower than expected counts of crime concentrating nearby. These results highlight the importance of disaggregating both crime and location types to better understand the complex relationship between greenspaces and crime.

Introduction

Greenspaces are an important element of urban life. They provide space for city residents to experience nature, exercise, play sports, or relax. The term greenspace encompasses a number of different public spaces, including parks, public gardens, and

natural areas; as such, they serve a variety of different purposes. Current research maintains that greenspaces provide a number of social and health benefits to neighborhood residents, including filtering toxins, countering the urban heat island effect, and strengthening place attachment and social cohesion (Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Yang et al., 2005). Despite these benefits, however, criminological research suggests that greenspaces may also generate crime (Groff & McCord, 2011; Kimpton et al, 2017; McCord & Houser, 2017; Taylor et al., 2019), although this relationship varies by the greenspace type (Kimpton et al., 2017; Shepley et al., 2019). Understanding the relationship between crime and greenspaces is necessary if we want to preserve these spaces, as well as the benefits they provide. This study aims to examine this relationship in one urban environment: Portland, Oregon. By disaggregating greenspace and crime types, and using a modified-street buffer method, the goal of this study is to further understanding of the complex relationship between greenspace and crime. If we are able to determine what types of greenspaces appear to have a problem with crime, we can better focus our efforts to make improvements and reduce crime.

Literature Review

Research concerned with the relationship between crime and place types has its roots in the field of environmental criminology. This group of theories focus on the spatial aspect of crime, emphasizing *where* crimes occur. They prioritize understanding the criminal event rather than criminal motivation.

Routine Activity Theory. One of the most prominent environmental criminology theories is routine activity theory, which was first presented in Cohen and Felson's 1979

article, “Social Change and Crime Rate Trends: A Routine Activity Approach.” This approach differed from theories that came before it, falling into the group of “opportunity theories” as opposed to offender-motivation theories that were more common at the time (Wilcox & Cullen, 2018). In its simplest form, routine activity theory posits that crime will (and can only) occur when three elements converge in *space and time*: a motivated offender, a suitable target, and the absence of a capable guardian (Cohen & Felson, 1979).

Geometry of Crime. Another prominent theory used to explain the relationship between crime and place is Brantingham and Brantingham’s geometry of crime approach. This theory introduces several new concepts to explain why crimes concentrate in certain places, while avoiding other locales (Brantingham & Brantingham, 1981). In this approach, the urban landscape is broken into subcomponents that help to explain how people use and move through these spaces. Pathways refer to the locations that people use to move through (e.g., roads, paths, rail systems), while nodes refer to the places that people spend a lot of time (i.e., any location). Edges refer to physical and perceptual (i.e., social) boundaries, and can include sharp edges such as a river, or fuzzy edges, such as gradual land use changes.

The pathways and nodes frequented by an individual make up their activity space which, along with surrounding areas, makes up the awareness space (Brantingham & Brantingham, 1993). These refer to the areas in which an individual spends most of their time and are therefore familiar with. Major pathways and nodes—those that are part of many individuals’ awareness spaces—are therefore more likely to experience higher levels of crime because they offer more opportunities. The Brantinghams term these as crime generators and crime attractors. The former refers to non-residential places that attract a lot

of people for non-criminogenic reasons (e.g., shopping malls), which experience an increased number of potential targets and offenders, generating more crime (Brantingham & Brantingham, 1995). An attractor, on the other hand, is a place known to be suitable for certain crimes, attracting motivated offenders for that reason (Brantingham & Brantingham, 1995). An example would be a specific place (e.g., park, bar) that is known for being a good spot to buy illegal drugs due to the absence of capable guardians and presence of motivated offenders. All of these features are influenced by their environmental context, or backcloth, which changes over time, and highlights the fluid, temporal aspects of place.

Crime Concentration. Guided by routine activity theory, Sherman and colleagues made note of the fact that offenders and targets have to converge in space and time when examining the concentration of predatory crimes in Minneapolis (Sherman et al., 1989). This study introduced the ideas of crime hot spots—places where crime events concentrate—which has since found a large amount of support in criminological research (Sherman et al., 1989; Weisburd et al., 2004; Andresen et al., 2017). Sherman and colleagues recognized that the nonrandom distribution of crime could be caused by the nonrandom distribution of people, or that certain places, by virtue of their routine activities, could be criminogenic (Sherman et al., 1989). Research on hot spots has generally supported the latter hypothesis, finding certain types of places (e.g., bars, malls, parking lots) to be more criminogenic (Bernasco & Block, 2011; Drawve & Barnum, 2018; Hart & Miethe, 2014). Even within place type categories (e.g., different types of bars), research has identified an uneven distribution of crime and, as Wuschke and Kinney argue, exploring disaggregate land use and place type categories can give us a better

understanding of the specific places that are associated with high levels of crime (Wuschke & Kinney, 2018). A similar argument has been made for disaggregating crime types, with Andresen and Linning arguing that different crime types result from different opportunity structures and, therefore, the spatial patterns and hotspots of different crimes will differ (Andresen & Linning, 2012).

Greenspaces and Crime. In the past decade, several studies have examined the relationship between greenspaces and crime in urban environments. The term greenspace refers to areas "synonymous with nature" and encompass a number of different place types, including neighborhood parks, forests, gardens, and vegetated areas (Shepley et al., 2019, p. 5120). Due to the broad nature of the term, studies often attempt to narrow this focus, either breaking greenspaces up into types based on specific features (e.g., amenity) or focusing solely on one type (e.g., parks) (Breetzke et al., 2020; Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017; Taylor et al., 2019).

There is a conflict between criminological theories on whether greenspaces act as crime attractors or generators, or whether these locations serve to reduce nearby crime. Theoretically, greenspaces that draw in a number of legitimate users may experience low levels of crime due to the increased levels of guardianship (Breetzke et al., 2020; Groff & McCord, 2011; Kimpton et al, 2017). In a 2019 evidence synthesis, Shepley and colleagues concluded that, based on the results of 45 quantitative and qualitative studies, the presence of parks and other greenspaces reduced urban crime (Shepley et al., 2019). A recent study of the relationship between greenspace and gun violence in Detroit found that greenspaces had a lower density of gun violence, suggesting that residents are not attracted to the

unmaintained greenspaces and that, due to this low usage, they are unable to function as crime generators (Breetzke et al., 2020).

Other research has contradicted this finding, indicating that greenspaces can act as crime generators or attractors. Groff and McCord, as well as McCord and Houser, both found evidence of this in their examination of neighborhood parks in Philadelphia and Louisville, respectively. Both studies found an increased concentration of violent, property, and disorder crime events found both in and around park spaces (Groff & McCord, 2011; McCord & Houser, 2017). Further, greenspaces that are unmaintained or of low quality could discourage use by legitimate users, turning it into a crime attractor where the lack of guardianship encourages criminal activity (Cohen & Felson, 1979; Groff & McCord, 2011). Breetzke and colleagues did not find this to be the case regarding gun violence, however, Groff and McCord did determine that a higher number of in-park activity generators (e.g., sports fields) was associated with a significantly lower amount of crime, suggesting that the increased guardianship from legitimate users of the space may deter crime (Breetzke et al., 2020; Groff & McCord, 2011).

Recognizing the impact that the presence of amenities and activity-generators could have on greenspaces, Kimpton and colleagues examined the relationship between crime and four greenspace types: “amenity rich,” “sit or play,” “transport,” and “amenity poor” (Kimpton et al., 2017). Recognizing that the uses of greenspaces are heterogeneous, the authors posited that their ability to generate crime may differ. This was supported by their findings. They found that public nuisance crime occurred disproportionately in “sit and stay” and “transport” greenspaces, the types that would likely be more resistant to outsiders (Kimpton et al., 2017). Additionally, they found that property damage crime occurred

disproportionately in “amenity rich” and “amenity poor” greenspaces, which could be explained by the higher number of available targets (in “amenity rich”) or the low number of guardians (in “amenity poor”) (Kimpton et al., 2017).

An alternative approach is that greenspaces could act as edges, where “outsiders” are not easily identified, making them places where people may be more comfortable committing crimes due to the anonymity and reduced likelihood of being confronted (Brantingham & Brantingham, 1993). In 2014, Hipp and colleagues found support for this, finding that parks can function as “social holes,” reducing residents’ sense of cohesiveness and attachment to their neighborhood (Hipp et al., 2014). Thus, current research on greenspaces reflects these theoretical conflicts, with some studies finding that the presence of a greenspace is not associated with crime while others find a strong relationship (Boessen & Hipp, 2018; Breetzke et al., 2020; Groff & McCord, 2011; Kimpton et al, 2017; McCord & Houser, 2017; Taylor et al., 2019; Shepley et al, 2019;).

The research discussed above has greatly improved our understanding of the relationship between greenspaces and crime. It is clear that they play important roles in the urban landscape, providing a local meeting space with numerous health and social benefits (Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Yang et al., 2005). In some contexts, they can act as crime attractors or generators, resulting in more crime at and around these locations (Groff & McCord, 2011; McCord & Houser, 2017). In other contexts, they appear to exhibit protective elements (Breetzke et al., 2020). Given the range of greenspace types, as well as the range of different crime types, we don’t yet know enough about the relationship between crime and greenspaces. By building on existing work and conducting a thorough analysis of multiple greenspace and crime types, we can

expand our understanding of these important locations to determine what types of greenspaces need attention, specifically in Portland. This will allow us to prevent crime, protecting these places, and the numerous benefits they provide for community residents.

Current Study

There are 318 greenspace locations within the City of Portland, Oregon (Portland Parks and Recreation, 2022). These include numerous types of greenspaces, such as parks and community gardens. A recent survey of Portland residents reported that 94% of respondents had visited a Portland park at least once in the past 12 months and roughly 50% reported visiting at least weekly (Portland Parks and Recreation, 2017). Further, in 2014, the Parks Replacement Bond was approved, providing $68 million dollars to make urgent repairs and improvements to Portland greenspaces (Portland Parks and Recreation, 2022). This Bond is still in progress, making vital improvements to prevent closures of greenspaces in the city. Thus, it is clear that greenspaces are an important element of the urban landscape in Portland. Despite this, no studies have examined the relationship between these locations and crime locally. Understanding this relationship could be vital to practitioners who are making decisions regarding improvements, allowing them to prioritize the implementation of preventive measures if greenspaces appear to be criminogenic. Determining which greenspaces, or what type of greenspaces, have a crime problem is vital in ensuring that resources and funding are allocated effectively. Therefore, the goal of this study is to determine whether or not crime concentrates around greenspaces in Portland and how this may differ by location and crime type. This study seeks to answer three key research questions:

1. Do crime events concentrate in and around greenspaces within Portland?
2. Does the level of concentration vary by crime type?
3. Does the level of concentration vary by greenspace type?

Data and Methodology

Data Preparation. The study area for these analyses is the Portland city limit. Data for these analyses were obtained from several sources. First, Oregon Metro's Regional Land Information System Portal (RLIS Discovery) was used to obtain spatial files, or shapefiles, for the city boundary, major rivers, and the road network (Oregon Metro, 2022). A greenspace shapefile was obtained from the Portland Map open data portal (PortlandMaps, 2022). The initial greenspace shapefile included 318 locations and provided the location name and size. Three were excluded because they fell outside of the city boundary, resulting in 315 discrete greenspaces within the Portland city limits.

The Portland Parks and Recreation website was used to collect information on greenspaces, including the city section (Downtown, East, Northeast, North, Northwest, Southeast, and Southwest), the different amenities present (n = 35) at the park (coded as a binary: 1 = present, 0 = not present), and the greenspace type (park, natural area, arboretum, public garden, rose garden, community garden, community and arts center, community school, memorial, museum, swim pool (indoor), swim pool (outdoor), golf course, raceway, and rental facility) (Portland Parks and Recreation, 2022). For the purpose of this study, the definition of greenspace is any public space that is predominately outdoors and contains vegetation in the form of grass, trees, or gardens. Thus, the study was limited to four location types, coded as follows: (1) parks, defined as greenspaces set aside for public

recreation, sports, or leisure use; (2) natural areas, which are greenspaces with no official designated purpose, tend to be less maintained and offer walking/hiking trails; (3) public gardens, which include rose gardens and arboretums, and refer to greenspaces that provide space for residents and visitors to view/experience nature; and (4) community gardens, defined as greenspaces where the primary purpose is to grow and provide produce for community residents. Category 1, parks, were further disaggregated into small parks (smaller or equal to 10 acres) and large parks (larger than 10 acres). This was done to distinguish between smaller neighborhood parks, more frequently examined in park-crime studies (Groff & McCord, 2011; McCord & Houser, 2017), and larger parks that may draw in visitors from further away, offering trails or other specific activities (e.g., rose gardens).

This information was coded for 317 locations listed on the Portland Parks and Recreation website. There was a discrepancy between the locations included in the shapefile and those on PPR's website due to the fact that this site only includes locations officially recognized by the city, thus some community gardens and natural areas included in the shapefile were not recorded on the website. The data from the website was joined to the shapefile in ArcGIS Pro, resulting in a match of 236, with 2 falling outside of the city boundary (n = 234). Of these, 11 were excluded because they were not classified as one of the included greenspace categories listed above. One park location, Mill Ends park, was excluded due to its small size (0.00036893 acres) which doesn't allow for any use of the space by people, making it not comparable to other locations (n = 222). An additional ten locations were excluded when creating greenspace environs (discussed below) because the surrounding buffer could not be clipped to the street buffer (because they were far away

from the street). This included four community gardens, four natural areas, and two parks, resulting in a final count of 212 locations, broken up as shown in table 2-1.

Table 2-1. Greenspace Locations Included in Analysis

Greenspace Type	*f*	%
Park	151	71.2%
Large Park (>10 acres)	48	22.6%
Small Park (≤10 acres)	102	48.1%
Natural Area	25	11.8%
Public Garden	7	3.3%
Community Garden	30	14.2%
	212	

Crime event data for the years of 2016 through 2019 were obtained in CSV format from the Portland Police Bureau's (PPB) open data portal (Portland Police Bureau, 2022). This dataset contains the event type, date of occurrence, time of day, and X/Y coordinates aggregated to the nearest intersection or street midpoint. A total of 236,083 events occurred between 2016 and 2019. PPB excludes the case number and address data for any cases deemed sensitive due to the nature of the crime (e.g., sex crimes or kidnapping) or victim, the victim-offender relationship, or the investigation status (Portland Police Bureau, 2022). Due to this, 26,445 (11.2%) events were excluded as they were missing location data. The events with available X/Y data were displayed using ArcGIS Pro and 1,022 events were excluded as they fell outside of the city boundary (n = 208,616). All crime was used as an aggregate category, as well as crimes against persons, property, and society, as defined by the PPB. Specific crime types were also included. These were selected based on the number of events (the three/four within each crime against category with the highest number of

events), as well as on what crimes would be more likely related to the presence of the greenspace or would be occurring within the greenspace. This meant that crimes such as burglary (which occur in a residence or commercial place) were not broken down into specific crime types but were still included in the all-crime and crime against categories.

Methodology. Crime concentration around discrete places is frequently measured using location quotients (LQs). The LQ allows for simple comparisons between sub-areas within an area (Wuschke et al., 2021a). A recent adaption of the LQ is as a rate ratio where the crimes within a small area are standardized by the same measure in the overall study area (Wuschke et al., 2021a). The LQ is calculated as:

$$LQ = \frac{Ce/Ae}{Cb/Ab}$$

Where

LQ = Location quotient

C_e *= Count of crime occurring in sub-area (environ)*

A_e *= Area of sub-area (environ)*

C_b *= Count of crime occurring in study area (street buffer)*

A_b *= Area of study area (street buffer)*

A value of 1.0 means that the level of crime within the sub-area is the same as the overall study area, while a value below 1.0 suggests that the sub-area has lower crime levels, and a level above 1.0 suggests that the sub-area has higher crime levels (Wuschke et al., 2021a). While there is currently no widely-accepted statistical metric to indicate significant concentration, this study considers a LQ of 2.0 to be meaningful as this suggests

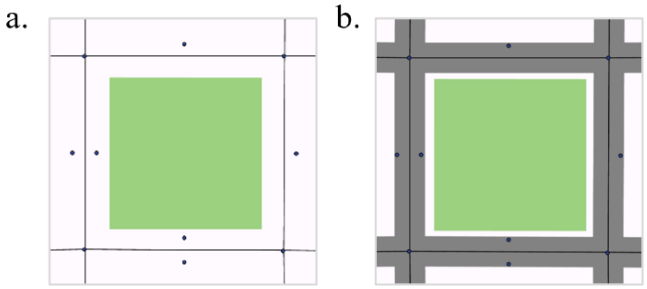
that crime is twice as concentrated in the area around greenspaces compared to the city as a whole (Groff & McCord, 2011; Wuschke et al., 2021a).

While LQs provide a simple way to interpret the level of crime concentration in an area, there are three limitations worth discussing. First, LQs are subject to the modifiable area unit problem (MAUP) due to the fact that they measure crime within a sub-area, in comparison to a wider area location. This means that choosing the unit of analysis, for both the numerator and denominator, is important as the unit of aggregation could impact the results (Openshaw, 1984; Wuschke et al., 2021a). Second, studies using LQs often use Euclidean buffers to create the unit of analysis, designed to act as the sub-area—or environ—around a specific location in which to capture crime events (Groff & McCord, 2011; McCord & Houser, 2017). These measures select all of the area within a set distance of the feature of interest (in this case, greenspaces) and are used to identify crime events that fall within the environ. However, as the LQ calculation typically uses area to standardize crime counts, this method results in denominator inflation by including spaces in which crime events are unlikely to occur (e.g., in the middle of bodies of water). Third, and related to this, police departments, including Portland Police Bureau, aggregate and generalize crime data to the road network, meaning that these buffers often include area where crimes may occur but will not be represented within public police records leading to the same problem of denominator inflation. In a recent study, Wuschke and colleagues presented a modified version of the LQ, using the length of the road network as a denominator, rather than areas as measured within a standard Euclidean buffer. By changing the method of standardization from area to length, this method ensured that any locations that could not be linked to reported crime incidences would not be included,

therefore reducing the issue associated with an over-inflated denominator (Wuschke et al., 2021a).

With regard to the current study, figure 2-1a shows the aggregation of crime points recorded by the Portland Police Bureau (PPB). Because the crime points are slightly offset from the street network, this study proposes a novel methodological adaption to Wuschke and colleague's street network measure (Wuschke et al., 2021a). Instead of using the typical Euclidean distance buffer method, this study used a modified buffer method to ensure that the area included in the LQ calculations are minimized. The goal of this method is to use the street-network as the basis for Euclidean buffers, selecting all locations where crime events may be recorded to, while excluding all areas where crime points could not be recorded. Figure 2-1b shows the result of this street buffer. A distance of 20 feet on each side of the street line (40 feet in total) was used to ensure that the vast majority of crime points were included within this analysis, while limiting the total area as much as possible.

Figure 2-1. Aggregated Crime Points (a) and Street Buffers (b)

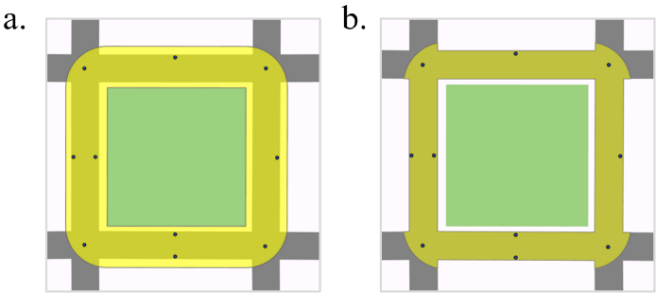


The street network buffer formed the adapted study area and was used as the denominator area in the LQ calculations (A_b used in place of the overall area of the city as a whole). This reduced the overall area by 86.4% from the total Portland area

(4,049,211,040.5 square feet) to the street buffer (535,541,364.8 square feet), removing all locations where crime events are typically not recorded.

In addition to street network buffer base map, additional 60-foot buffers were created around greenspaces to act as the 'environ' (Groff & McCord, 2011). The environ is used for two key reasons: (1) due to the way crime data is aggregated to the street, the environ captures all crime points on the surrounding streets that could have occurred within the greenspace, and (2) theoretically, the streets around the greenspace fall within the environmental backcloth and crime on these streets could be influenced by the presence of the greenspace (Groff & McCord, 2011). These environ buffers were designed to include the streets and intersections that immediately surround each greenspace, as well as crime events located on both sides of these surroundings streets. In order to capture all surrounding streets and intersections, a 60-foot distance surrounding all greenspaces was needed. This buffer was then clipped to the Portland street network buffer, once again to exclude areas where crime events would not be represented. This step acted to remove any area that was captured by the environ buffers (LQ numerator) but not the street buffer (LQ denominator). This step removes the greenspace area itself, as PPB crime events are only reported along the street and are therefore not able to be located within the actual greenspace area. Figure 2-2 illustrates this process and the result. In Figure 2-2a, the traditional Euclidean buffer was created around the greenspace. This captures all of the area within a 60-foot range of the greenspace itself. In Figure 2-2b, this buffer was clipped to the street buffer, excluding any area from being captured that was not in the street buffer as well.

Figure 2-2. Creating Greenspace Environs



While the vast majority of crime event data fell within the Portland street network buffers, a small proportion of incidents were located in areas outside of this buffer (1.4%, 2,988). Most of these were either along the Portland waterfront or around the Lloyd Center, a large mall in East Portland. These events were therefore excluded from the analyses. This resulted in a total of 205,628 incidents which were then broken up into specific crime categories used in the analyses: (1) all crime, which includes all incidents recorded by the PPB; (2) property crimes; (3) person crimes; and (4) society crimes (e.g., public order crimes). Nine discrete crime types were included: theft from motor vehicles (MV), motor vehicle theft (MVT), vandalism, robbery, simple assault, intimidation, aggravated assault, drug and narcotic violations, and weapon law violations.

Results

RQ 1: Do crime events concentrate in and around greenspaces within Portland?

Between 2016 and 2019, 6,742 out of 205,628 criminal incidents (3.3%) occurred within a greenspace environ. With a LQ of 1.2, aggregate level crime (all crime) does not appear to concentrate around local greenspaces. Breaking this down by crime and greenspace type, however, we see different results.

RQ 2: Does the level of concentration vary by crime type?

Table 2-2 displays the frequency, LQ, and percentage of each crime type within the greenspace environ. At the aggregate level, crime does not appear to concentrate around Portland greenspaces. This includes all crime (1.2), as well as the sub-categories of property crime (1.1), person crime (1.7), and society crimes (1.9). However, when disaggregating by crime types, drug and narcotic violations do appear to concentrate around greenspaces, with a LQ of 2.1. One crime type, motor vehicle theft (MVT) has a LQ of 0.8, suggesting that it is slightly less concentrated around greenspaces compared to the city as a whole. The remaining categories all exhibit higher concentration in the spaces immediately surrounding greenspaces, though none reaching the 2.0 threshold.

Table 2-2. Concentration of Crime at and near Portland Greenspaces

	Total *f*	**Environ *f***	**LQ**	**% of Total**
All Crime	205,628	6,742	1.2	3.3%
Property Crime	179,707	5,424	1.1	3.0%
Theft from MV	39,569	1,474	1.3	3.7%
MVT	25,310	568	0.8	2.2%
Vandalism	22,465	835	1.3	3.7%
Robbery	3,657	168	1.6	4.6%
Person Crime	16,481	806	1.7	4.9%
Simple Assault	8,601	424	1.7	4.9%
Intimidation	3,279	142	1.5	4.3%
Aggravated Assault	4,591	240	1.8	5.2%
Society Crime	9,440	512	1.9	5.4%
Drug/Narc Violations	6,548	385	2.1	5.9%
Weapon Law Violations	2,007	109	1.9	5.4%

RQ 3: Does the level of concentration vary by greenspace type?

Next, the concentration of aggregate crime (all crime) was assessed for the different greenspace types, shown in table 2-3. Greenspaces classified as parks account for 86.0% (5,799) of the total crimes occurring around greenspaces (n = 6,742). There continues to be variation in the levels of crime concentration, with natural areas (0.4), community gardens (0.8), and large parks (0.9) all having LQs below 1, suggesting that crime is less concentrated around these spaces than in other spaces within the city. Both public gardens and the broad park category (large and small parks combined) have LQs above 1 (1.4 and 1.5, respectively), however both of these categories continue to display concentrations below the threshold of 2.0. When disaggregating parks into size-based categories, small parks display a meaningful concentration of aggregate crime, with an LQ of 2.1. Small parks account for 56.1% (3,781) of all crime occurring in greenspace environs, followed by large parks (29.8%).

Table 2-3. Concentration of Crime by Type of Greenspace

Greenspace Type	*f*	LQ	% of Greenspace Crime (n = 6,742)
Community Garden	113	0.8	1.7%
Public Garden	291	1.4	4.3%
Natural Area	645	0.4	9.6%
Park	5,799	1.5	86.0%
Large Park	2,011	0.9	29.8%
Small Park	3,781	2.1	56.1%

Note: total does not add to 6,742 due to a few instances of overlap between the environs of different greenspace types

Next, the relationship between different crime types and greenspace types were examined. Shown in table 2-4, a number of interesting relationships emerge. When

considering community gardens, intimidation offenses appear to concentrate with a LQ of 3.0. There is, however, only a small number of incidents near these locations, with 7 occurrences between 2016 and 2019. This high LQ is therefore most likely associated with an inflated rate metric, as a small number of occurrences concentrated in a small area can produce a relatively large incident rate. Shifting focus to public gardens, theft from motor vehicles (2.5), aggregated society crimes (5.3), drug and narcotic violations (7.1), and weapon law violations (2.0) all appear to concentrate in the environ. Again, a small crime count for weapon law violations (4) is seen in this area, likely resulting in an inflated LQ metric. Looking at natural areas, no crime type appears to concentrate in the environ. In fact, no crime type has a LQ above 1.0, suggesting crime is less concentrated in these environs compared to the rest of the city.

When exploring all greenspaces defined as parks (large and small combined), robbery (2.2), aggregated person crime (2.3), simple assault (2.3), aggravated assault (2.5), aggregated society crime (2.4), drug and narcotic violations (2.5), and weapon law violations (2.5) all appear to concentrate within the environ. When parks are broken up into large and small, however, large parks do not appear to experience any concentration, with no LQs above 2.0. On the other hand, small parks experience a meaningful concentration of almost all categories (and sub-categories) of crime. The only two crime types that do not meet the 2.0 threshold within this environ are the aggregated property crime category (1.8) and motor vehicle theft (1.1). There is, however, still variation in the number of different crime types and intensity of the concentration.

Table 2-4. Concentration of Crime Types around different Greenspace Types

	Community Garden	**Public Garden**	**Natural Area**	**Park**	**Large Park**	**Small Park**
	f (LQ)	*f* (LQ)	*f* (LQ)	*f* (LQ)	*f* (LQ)	*f* (LQ)
All Crime	113 (0.8)	291 (1.4)	645 (0.4)	5,799 (1.5)	2,011 (0.9)	3,781 (2.1)
Property Crime	95 (0.7)	221 (1.2)	565 (0.4)	4,631 (1.3)	1,723 (0.9)	2,905 (1.8)
Theft from MV	30 (1.1)	99 (2.5)	191 (0.6)	1,189 (1.5)	408 (1.0)	780 (2.2)
MVT	12 (0.7)	29 (1.1)	48 (0.2)	493 (1.0)	239 (0.9)	252 (1.1)
Vandalism	20 (1.2)	32 (1.4)	67 (0.4)	723 (1.7)	255 (1.1)	468 (2.3)
Robbery	3 (1.1)	3 (0.8)	6 (0.2)	159 (2.2)	41 (1.1)	118 (3.6)
Person Crime	16 (1.3)	19 (1.1)	52 (0.4)	730 (2.3)	183 (1.1)	546 (3.7)
Simple Assault	5 (0.8)	11 (1.3)	24 (0.3)	388 (2.3)	78 (0.9)	310 (4.1)
Intimidation	7 (3.0)	4 (1.2)	12 (0.5)	122 (1.9)	27 (0.8)	95 (3.3)
Aggravated Assault	4 (1.2)	4 (0.9)	16 (0.4)	220 (2.5)	78 (1.6)	141 (3.5)
Society Crime	2 (0.3)	51 (5.3)	28 (0.4)	438 (2.4)	105 (1.1)	330 (3.9)
Drug/Narc Violations	2 (0.4)	47 (7.1)	20 (0.4)	321 (2.5)	70 (1.0)	249 (4.3)
Weapon Law Violations	0 (0.0)	4 (2.0)	8 (0.5)	99 (2.5)	30 (1.4)	68 (3.8)

Discussion

The relationship between greenspaces and crime is important to understand, given the positive, and necessary, role they play in the urban environment. The goal of this study was to further examine this relationship in Portland, Oregon. The first research question this study sought to explore is whether crime concentrates around Portland greenspaces. The results suggest that, overall, crime does not concentrate around Portland greenspaces. This is in line with the findings of Breetzke and colleagues (2020) who found the presence of greenspaces was not associated with gun violence in Detroit. Once crime is broken down into more discrete categories, however, we see different levels of concentration for different crime types. The aggregate crime categories (all crime, property crime, person crime, and society crime) do not appear to concentrate around greenspaces, as measured by LQ values less than 2.0. When looking at the discrete crime types, LQs range from 0.8

(Motor vehicle theft) to 2.1 (drug and narcotic violations), reinforcing the central argument of Andresen and Linning (2012) who emphasize the importance of disaggregating crime types. In this case, motor vehicle thefts may not concentrate around greenspaces because there are fewer suitable targets (i.e., no parking lots, people walk to the greenspace instead of driving), while drug and narcotic violations may concentrate because greenspaces offer adequate cover for these crimes or a lack of guardianship to prevent them.

Disaggregating greenspaces also reveals differing levels of crime concentration, suggesting that different types of greenspaces may have different relationships with crime. This study reiterated that small parks experience crime concentration, consistent with prior studies of parks and crime (Groff & McCord, 2011; McCord & Houser, 2017), suggesting that there is something about this particular greenspace category that may be criminogenic. In Portland, small parks were found to have a high concentration of aggregate crime, with an LQ of 2.1, while natural areas, community gardens, public gardens, and large parks each did not meet the 2.0 threshold. This suggests that the latter greenspace types do not experience a concentration of crime, with some having lower concentration compared to the rest of the city, and perhaps exhibiting a protective element.

The relationship between greenspace types and crime also varied based on the crime type, with all greenspace types—with the exception of natural areas and large parks—experiencing a concentration of at least one crime type. This suggests that different greenspace types may provide opportunities for certain crimes, but not others. For example, public gardens were found to have a high concentration of thefts from motor vehicles (LQ of 2.5). This could be because these public gardens draw in visitors from far, who travel in their vehicles and leave them unattended nearby while enjoying the greenspace. Small

parks, on the other hand, experience concentration for all but one discrete crime category (motor vehicle theft). This could be because there is a lack of targets (i.e., cars) or because these parks do not offer the opportunity for this crime (e.g., presence of guardianship).

The fact that different greenspace types have differing levels of crime concentration is consistent with the work of Wuschke and Kinney (2018) who argue that breaking down land use categories can help us gain a clearer understand of the specific relationships between crime and place (Wuschke & Kinney, 2018). Kimpton and colleagues recognized this heterogeneity as well, classifying them based on the number of amenities present (Kimpton et al., 2017). While greenspaces in this study were not grouped based on the number and type of amenities present, the greenspace types as defined by the City of Portland allow for the distinction between greenspaces that would be used for different purposes. For example, natural areas or large parks with trails will be used in a different way to community gardens or a small neighborhood park.

These results suggest that Portland greenspaces generally do not act as crime generators or attractors, with the exception of small parks which experience a high concentration of most crime types. However, as this study did not test the effect of amenities present at these locations on crime, more research on this relationship is needed to determine whether the concentration of crime at these parks is related to their role as a crime generator or attractor.

The methods used in this study improve upon common LQ measures relying on traditional Euclidean buffers. By limiting the study area to a small zone surrounding the city's street segments, areas where crime is unlikely to occur, or unlikely to be recorded on, are removed from the analysis. Removing these spaces helps to avoid rate inflation,

which is a common concern with rate-based measures such as the LQ. When calculating crimes per area, a large denominator (such as the area of the entire city) falsely reduces the overall city-wide rate of crime. As a rate ratio, the LQ then compares the relatively low city-wide measure to related calculations of crime within smaller sub-locales. Even small counts of crime in these sub areas can appear meaningful as a result. By removing all area where the PPB does not record criminal events, and further limiting the area to the street buffer, the impact of a large denominator is minimized. This method offers an improved design to accommodate crime data that has been offset from the street network, or is otherwise unconnected (i.e., is not associated with a street address). As more police departments begin to provide public access to crime data, methods to best represent and measure patterns using these public sources become ever more important (Wuschke et al., 2021b). The crime data publicly available from the Portland Police is similar to that provided by other agencies in that it aggregates crime points in an effort to anonymize the data. Thus, developing meaningful ways to measure crime concentration using data that is publicly accessible is critical for continued research exploring spatial patterns of crime.

Limitations and Future Directions

The methods used in this study are an improvement over the traditional Euclidean buffer approach, however, there are a few limitations worth noting. First, this study uses one measure of crime concentration—the location quotient. While the LQ is a powerful and easy-to-understand measure of the concentration around locations of interests, there are still limitations associated with this measure. LQs, like most rate-based measures, are subject to rate inflation as was seen in several instances where the crime count was low,

but the small area resulted in a meaningfully high LQ. Thus, it is important to interpret the results of this study while being mindful of both the count of crime and the LQ value.

Further, the street network buffer method used in this study is quick, relatively computationally light, and allows for a considerable reduction in area measures used within this study. However, the buffers themselves are still Euclidean in design, selecting all areas within 20 feet of a roadway. This means that they may falsely make connections between two nearby streets, even if these areas are not physically connected. Further, the park environs are also Euclidean in nature. When clipped to the street buffer, this allows them to still capture and include area that may not be physically connected to the park (e.g., a dead-end street that falls within the 60-foot environ area). For the purposes of this study, the lack of physical connectivity via road networks is likely to be minimally impactful, as there are countless informal paths that connect dead-end roads to other nearby routes. In areas or studies where accurate topographic connections are critical, network-based analysis would offer a more topographically accurate approach.

This study focused on determining whether crime (and different crime types) concentrates around different greenspace types in Portland. While this is an important contribution and necessary precursor to further studies of parks and crime in Portland, it is exploratory. As such, it did not consider other factors including the amenities present at greenspaces, neighborhood characteristics, the surrounding land use, how crime patterns change moving further away from greenspaces, or temporal factors (Andresen & Linning, 2012; Groff & McCord, 2011; McCord & Houser, 2017; Boessen & Hipp, 2018; Taylor et al., 2019). Future research can further explore this topic by considering the influence of different amenities present at greenspaces (e.g., sports courts, public transit), neighborhood

characteristics (such as poverty levels and social disadvantage), surrounding land use (e.g., residential, commercial), the area beyond the parks, and temporal patterns of greenspace crime.

Conclusion

This study aimed to understand the relationship between greenspaces and crime in Portland, Oregon, using an adapted street network buffer to better measure the concentration of crime around greenspaces, while avoiding the pitfalls of Euclidean buffers. This proposed method offers an improved way to measure crime concentration using publicly available, aggregated crime data, that may not be suitable for network-analyses. Overall, greenspaces in Portland do not appear to experience a concentration of crime. However, new patterns emerge as greenspace types and crime types are disaggregated. This study identified small parks as experiencing a concentration of crime, which was consistent when crime was broken down into discrete types. Only one crime, motor vehicle theft, was not concentrated around small parks. Other greenspace types were found to only experience a concentration of certain crime types, or none at all. Community gardens experienced a concentration of intimidation events, while public gardens experienced a concentration of thefts from motor vehicles, drug and narcotic violations, and weapon law violations. Large parks and natural areas did not experience concentration of any crime, suggesting that these may be protective. Future research is needed to further our understanding of these relationships, considering additional factors and temporal patterns of crime.

Appendix

Table 2-5. Greenspace Type Coding

Classification Type	Code	Notes
Park	1	
Natural area	2	
Arboretum Public garden Rose garden	3	grouped as public garden
Community garden	4	
Community and arts center Community school	5	grouped as community and arts center or school
Memorial Museum	6	grouped as memorial/museum
Swim pool (indoor) Swim pool (outdoor)	7	grouped as swimming pool
Golf course	8	
Raceway	9	
Rental Facility	10	

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Chapter 3: Manuscript 2 – A Walk in the Park: A Spatial Analysis of Portland Parks and Crime

Abstract

Parks are an important element of the urban landscape, providing a space for residents to exercise and relax. Research suggests that these locations provide numerous health and social benefits for urban residents, including strengthening place attachment and reducing air pollution (Yang et al., 2005; Mason, 2010; McCunn & Gifford., 2014). Despite these benefits, criminological theories conflict regarding whether or not parks function as crime generators, with research on these locations reflecting this conflict (Boessen & Hipp., 2018; Groff & McCord, 2011; McCord & Houser, 2017). This study adds to existing literature by examining the relationship between parks and crime in Portland, Oregon. This study uses a methodological adaption to measure crime concentration around specific location types using a street network buffer. This adaption offers an improved method for working with aggregated crime data that is unsuitable for a network analysis. The results of the study suggest that small parks in Portland experience a concentration of crime, although this varies by crime type. Further, there is a non-linear relationship in the level of concentration and distance from the park. An examination of park amenities show that certain features and in-park activity generators are associated with higher and lower levels of crime, and this varies by crime type. The surrounding land use zoning is also linked to crime, with residential zoning being associated with lower crime levels in and around parks. These results have implications for crime prevention approaches at Portland parks, as well as for future research on this complex relationship.

Introduction

As public spaces, urban parks serve a variety of purposes and are an important element of city life. Parks provide places where people can go to exercise, play sports, interact with one another, or relax. Research on these spaces suggests that they support mental and physical health and may increase the sense of community within an area (Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Taylor et al., 2019; Yang et al., 2005). In spite of this, criminological theories conflict when examining the relationship between parks and crime (Boessen & Hipp, 2018; Groff & McCord, 2011). On one hand, routine activity theory (Cohen & Felson 1979), may suggest that a well-used park would have increased levels of guardianship due to the number of people in the space, and therefore may offer a crime reduction effect. On the other hand, the increased number of targets (i.e., individuals or their property) offer a variety of opportunities for crime, and therefore, could lead to increased levels of crime at and around parks. This conflict has been highlighted in past studies examining the park-crime relationship, with some studies finding that parks appear to be criminogenic (Groff & McCord, 2011; Kimpton et al., 2017; McCord & Houser, 2017; Taylor et al., 2019) while others find that there is less crime in and around parks and greenspaces (Boessen & Hipp, 2018; Breetzke et al., 2020).

In the past decade, multiple studies have measured the effect of neighborhood parks on crime, focusing not only on the park, but also the effects of surrounding land use and park amenities on this relationship (Groff & McCord, 2011; McCord & Houser, 2017). Such studies suggest that these factors play a role in determining the strength of the relationship between the park and crime, with some being associated with higher crime while others appear to be protective (Groff & McCord, 2011; McCord & Houser, 2017;

Taylor et al., 2019). Furthermore, while studies on crime concentration suggest that a small proportion of a certain type of place will have most of the crime (Eck et al., 2007), current research suggests that the concentration of crime at parks is consistent for most parks, rather than only a few parks (Groff & McCord, 2011; McCord & Houser, 2017). This makes it imperative to understand what factors influence the likelihood of crime at parks so that targeted crime prevention practices can be developed and deployed.

The goal of this study is to contribute to the growing literature on parks and crime by examining this relationship in Portland, Oregon. For the purpose of this study, parks refer to publicly owned areas that are designated as a "park" by the City of Portland, as opposed to a "community garden" or "public garden." These are areas that are set aside for public recreation, sports, or leisure use. Guided by previous research within Portland (see Chapter 2) and beyond (Groff & McCord, 2011; McCord & Houser, 2017), these parks are limited to those smaller than 10 square acres to ensure the spaces being measured are consistent in use and are assumed to be primarily used by local residents rather than drawing outside users (e.g., for hiking, camping). Proposing a new method of measuring and calculating location quotients, this study tests whether crime concentrates at and near parks in Portland, as has been found in previous studies (Groff & McCord, 2011; McCord & Houser, 2016). Further, it tests the association of internal (amenities) and external (surrounding land use) factors and crime levels. Understanding these complex relationships between, parks, crime and the associated factors is vital if we are to develop targeted and effective crime prevention approaches that will help to preserve park spaces and all of the benefits they provide.

Literature Review

Research that examines the relationship between parks—or any place type—and crime has its roots in the field of environmental criminology. This group of theories emphasize the spatial aspect of crime: *where* crime occurs. In this way, they focus on the criminal event itself. Several key concepts guide this work, including crime generators and attractors, as well as the risky facility framework (Brantingham & Brantingham, 1995; Eck et al., 2007).

Crime Generators and Attractors. The assumption that parks would experience higher levels of crime is grounded in the notion of crime generators and attractors, as presented within the Brantingham's geometry of crime approach (Brantingham & Brantingham, 1995; Groff & McCord, 2011; McCord & Houser, 2017). In this approach, the Brantinghams simplify the built urban environment into a geometric model, focusing on the connections between spaces, as well as the way these spaces are used. Urban environments are defined by pathways (the locations that we move through) and nodes (places where we spend time). Using these basic geometric connections, the Brantinghams introduce the concepts of activity and awareness spaces (Brantingham & Brantingham, 1995). One's activity space is where an individual spends most of their time; while one's awareness space is the broader range of areas that the individual is familiar with. The authors posit that major pathways and nodes—which are part of many people's activity and awareness spaces—are more likely to experience higher levels of crime because of the number of opportunities present (Brantingham & Brantingham, 1995). They termed these crime generators and crime attractors.

Crime generators refer to non-residential places that attract a number of people for non-criminogenic reasons (e.g., a shopping mall), increasing the number of potential targets and offenders, thereby generating crime (Brantingham & Brantingham, 1995). Crime attractors, on the other hand, refer to places that are known to be suitable for certain types of crimes, attracting motivated offenders for that reason (Brantingham & Brantingham, 1995). This could include a specific site that is known for being a good place to buy illegal drugs, for example. Because parks often bring together a number of people into the same environment, it is possible that these spaces could act as crime generators or attractors and could therefore be associated with higher levels of crime (Groff & McCord, 2011). In their 2011 study, Groff and McCord found support for this relationship, with violent, property, and disorder crime all being twice as high near parks compared to the rest of Philadelphia (Groff & McCord, 2011). In 2017, this study was replicated, finding similar results in Louisville (McCord & Houser, 2017).

Hot Spots and Risky Facilities. It is well-established that crime tends to concentrate in a small number of sites (Sherman et al., 1989). In their study examining the spatial distribution of predatory crime, Sherman and colleagues found that approximately 50 percent of calls came from approximately 3 percent of places, terming these locations as "hot spots" (Sherman et al., 1989). Since this study, a large amount of research has found support for the concept of hot spots, with certain places tending to be more criminogenic and crime concentrating in a few high crime locations (Andresen et al., 2017; Bernasco & Block, 2011; Drawve & Barnum, 2018; Hart & Miethe, 2014; Weisburd et al., 2004). Further examination of different place types has also found that even within place type categories (e.g., shops), a small proportion account for the majority of crime. Eck and

colleagues term these hot locations “risky facilities” (Eck et al., 2007; Wuschke & Kinney, 2018). In addition to focusing on *where* crime concentrates, these studies often examine what factors drive this relationship, looking at different place types, their surroundings, and the features present (which can be protective or criminogenic) (Bernasco & Block, 2011; Drawve & Barnum, 2018; Eck & Guerette, 2012; Groff & McCord, 2011; Hart & Miethe, 2014; McCord & Houser, 2017; Piza et al., 2014; Reynald, 2009; Reynald, 2011; Wilcox & Cullen, 2018; Wuschke & Kinney, 2018).

Parks and Crime. The first empirical study examining the relationship between crime and neighborhood parks was that of Groff and McCord (2011). In this study, the authors examined this relationship in Philadelphia, aiming to uncover whether parks were associated with higher levels of crime in adjacent areas (Groff & McCord, 2011). They hypothesized that the parks would act as crime generators and would therefore be associated with higher levels of crime. Further, they examined the effect of amenities present at the parks, the surrounding land use, and how crime concentration changed as distance to the park increased (Groff & McCord, 2011). The authors used 50-foot Euclidean buffers around each park to serve as the “park environ” which captured crime data on the streets surrounding the parks because: (1) the crime data did not distinguish between crimes that occurred in and outside of the park, and (2) the streets surrounding the park form part of the situational backcloth of the park—crime occurring there could be influenced by the park’s presence (Groff & McCord, 2011). The authors used location quotients (LQs) as a measure of crime concentration. Additionally, they statistical compared the clustering of crime at parks to random city intersections and found that crime

did cluster in and around parks, and this was consistent for violent, property, and disorder crime (Groff & McCord, 2011).

The findings of this study suggested that crime at parks was twice as concentrated compared to the rest of Philadelphia. In addition, they identified a nonlinear relationship between crime and distance to the park, with the concentration of crime decreasing one block away (400ft buffer) but increasing again at the second block (800ft). Additionally, they found that sports amenities, park lighting, and the presence of public transit at the park were protective features and that parks surrounded with non-residential land use had the lowest crime concentration (Groff & McCord, 2011).

In 2017, McCord and Houser built off of the original study, replicating it in Louisville, Kentucky (McCord & Houser, 2017). Using the same methods as Groff and McCord's study, the authors found that crime was more clustered in and around parks in Louisville with all three types—violent, property, and disorder crime—being more than twice as concentrated in the park environ compared to the rest of the city (McCord & Houser, 2017). The findings of this study echoed that of Groff and McCord's original study with regards to the non-linear relationship between distance to the park and crime; however they found that different park amenities had an impact on the level of crime. Namely, they found that the presence of benches, parking lots, evidence of park adoption (i.e., ownership in the form of signage/names), and improved walkways were associated with lower crime (varying by crime type), while the presence of public transit and basketball courts were associated with higher crime (again, varying by crime type) (McCord & Houser, 2017).

Over the past decade, research examining the relationship between parks and crime has grown. The work of Taylor and colleagues built on the work of Groff and McCord,

addressing a key limitation of the original study: neighborhood context (Taylor et al., 2019). This study examined the role of park characteristics (e.g., amenities) in addition to several neighborhood characteristics, including social cohesion, socio-economic status, residential instability, the percent of immigration/foreign born population, the percent of young males (15-24) in the population, and racial and ethnic heterogeneity (Taylor et al., 2019). Their findings suggested that while disorder crime around parks was significantly related to social cohesion, violent crime around parks was affected by the occurrence of violent crime nearby and the presence of security fencing in or around the park (Taylor et al., 2019). Examining greenspaces as a broader location type, Breetzke and colleagues examined the relationship between greenspaces and gun violence in Detroit (Breetzke et al., 2020). The authors used three buffers at 100-meter intervals and found that gun violence was substantially less concentrated in greenspaces compared to the rest of the city, and the authors suggest that this could indicate that the concentration of crime around greenspaces may vary by crime type (Breetzke et al., 2020).

The research discussed above has greatly improved our understanding of the complex relationship between crime and parks. It is clear that parks play an important role in the urban landscape by providing health and social benefits to residents (Bowler et al., 2010; Mason, 2010; McCunn & Gifford., 2014; Yang et al., 2005). However, their effect on crime is unclear. In some cases, they seem to act as crime attractors or generators, resulting in higher levels of crime (Groff & McCord, 2011; McCord & Houser, 2017; Taylor et al., 2019). In other cases, they appear to be protective (Breetzke et al., 2020), with evidence of reduced crime in nearby areas. It is also clear that the presence of certain amenities or other characteristics of the parks, such as the surrounding land use, can

influence this relationship, either being associated with higher or lower levels of crime (Groff & McCord, 2011; McCord & Houser, 2017).

While advancements have been made, there is still room for further examination of the relationship between parks and crime. This study seeks to add to the current literature, enhancing our understanding of the relationship between crime and parks in three ways. First, the studies discussed above have examined this relationship in three major U.S. cities (Philadelphia, Louisville, and Detroit) finding that different factors influence the relationship between crime and parks depending on the locale. This study therefore seeks to add to this body of research by examining this relationship, as well as the influence of amenities and surrounding land use, in a new urban environment—Portland, Oregon, located in the country's Pacific Northwest. Second, as Andresen and Linning have argued, different crime types require different opportunities and therefore the spatial patterns may vary (Andresen & Linning 2012). The majority of existing studies have used aggregated crime groups (e.g., disorder, property) which could hide patterns occurring at a more micro-level (Andresen & Linning, 2012). Thus, this study seeks to test the relationship between a number of specific crime types and parks, to determine how this relationship changes when disaggregating crime. Third, previous studies often rely on Euclidean buffers to capture crime points and calculate location quotients. Euclidean buffers have an inherent limitation in that they capture all locations within a set distance of a feature of interest—including spaces where crimes would not occur (e.g., steep hills or water), as well as areas where crimes would not be recorded (Groff & McCord, 2011; Wuschke et al., 2021a). Therefore, this study seeks to adapt this method to exclude these reporting deserts. This adjustment aims to better capture and calculate the concentration of crime using location

quotients. By building on prior work and conducting a thorough analysis of small parks in Portland as well as various crime types, we can expand our understanding of these important spaces.

Current Study

In the city of Portland, there are 170 park locations (Portland Parks and Recreation, 2022). This includes parks of various sizes, ranging from Washington Park, which covers 410 acres and is home to numerous public gardens and the Oregon Zoo, to Mill Ends park, which is noted as the smallest park in the world with an area of 452 square inches (Portland Parks and Recreation, 2022). Parks play an important role in the lives of Portland residents, with a recent survey finding that 94% of respondents had visited a park at least once in the previous year and that roughly 50% visited parks at least once a week (Portland Parks and Recreation, 2017). Furthermore, in 2014, Portland residents voted in support of the Parks Replacement Bond, which provides $68 million to make urgent repairs and improvements to these locations (Portland Parks and Recreation, 2022). Despite the clear importance of parks to the city and its residents, no studies have examined the relationship between parks and crime in Portland. Understanding this relationship is vital for practitioners who are in the position to make funding decisions. They need to know where these resources need to be allocated and what factors to address at and around parks. Therefore, the goal of this study is to determine whether crime concentrates around neighborhood parks in Portland and what factors may influence this.

Preliminary results have found that general greenspaces in Portland did not have a concentration of crime, although this varied by both crime type and greenspace types. The

findings suggested that within the broad category of Portland's greenspaces, small parks do experience a concentration of crime; however, there was no further examination of this relationship and factors that may be associated with higher crime. As such, this study seeks to answer four key research questions (RQs):

1. Do crime events concentrate in and *around* parks within Portland?
2. Do some Portland parks behave as risky facilities, displaying higher concentrations of crime?
3. Is there an association between the amenities present at parks and crime concentration?
4. Is there an association between the surrounding land use and crime at and near parks?

Data and Methodology

Data Preparation. The study area was defined as the city of Portland, with a spatial boundary file obtained from Oregon Metro's Regional Land Information System Portal (RLIS Discovery) (Oregon Metro, 2022). All of the subsequent data layers were clipped to this boundary. Additional contextual layers obtained from RLIS Discovery included major rivers and the street network (Oregon Metro, 2022).

Portland Map's open data portal was used to obtain zoning data, which was used as a proxy for land use surrounding the parks, as well as the parks layer, which included details on the location, name, and size of parks in Portland (n = 318) (PortlandMaps, 2022). Park data was supplemented using Portland Parks and Recreation's website, which included information on the park type, city section, and different amenities present (n = 35) at the

park (coded as a binary: 1 = present, 0 = not present) (Portland Parks and Recreation, 2022). This was joined to the park shapefile in ArcGIS Pro 2.9.1.

This study aims to examine small neighborhood parks as has been done in prior studies (Groff & McCord, 2011; McCord & Houser, 2017). These are defined as open areas that are set aside for public recreation, sports, or leisure use, that are classified as parks by Portland Parks and Recreation, and that are less than 10 acres in size (Groff & McCord, 2011; McCord & Houser, 2017; Taylor et al., 2019). Thus, any locations that did not fit these criteria were excluded from the analysis, resulting in 105 small parks. An additional park, Mill Ends park, was excluded from this study because it was very small and therefore not comparable to other parks (n = 104).

The Portland Police Bureau's (PPB) open data portal was used to obtain crime data for the years 2016 to 2019 (Portland Police Bureau, 2022). This dataset contains information about the crime event type, the time and date of occurrence, and X/Y coordinates aggregated to the nearest intersection or street midpoint. Between the years of 2016 and 2019, there were a total of 236,083 events that occurred within the Portland city limits. X/Y data was not available for 26,445 (11.2%) of events to the sensitive nature of the crime (e.g., sex crimes). All crime was used as an aggregate category and specific crime types were also included. The specific crime types selected were based on the types with the highest counts within the three "crime against" categories: persons, property, and society. Also considered was which crimes would be more likely related to the presence of the greenspace or would be occurring within the greenspace. This meant that crimes such as burglary (which occur in a residence or commercial place) were not broken down into specific crime types but were still included in the all-crime category.

These events were excluded from the analysis and the remaining 209,638 were displayed using ArcGIS Pro. An additional 1,022 events were excluded as they fell outside of the city boundary, resulting in 208,616 crime events occurring in Portland between 2016 and 2019.

Methodology. When measuring crime concentration around specific places, location quotients (LQs) are frequently used as they allow for simple comparisons between sub-areas and a larger zone (Wuschke et al., 2021a). Originally used to provide a measure of specialization of crime in a sub-area compared to the whole, a more recent adaption of the LQ resembles a rate ratio, where the crimes within a sub-area are standardized by the same measure of the whole area (Wuschke et al., 2021a). When the value of the LQ is 1.0, this means that the level of crime in the sub-area is the same as the whole. A LQ value below 1.0 suggests that crime is lower in the sub-area, while an LQ above 1.0 means that crime is higher in the sub-area (Wuschke et al., 2021a). While there isn't an established LQ value considered significant, many studies consider an LQ of 2.0 to be meaningful as this suggests that crime is twice as concentrated in the sub-area (Groff & McCord, 2011; Wuschke et al., 2021a). The LQ is calculated as:

$$LQ = \frac{Ce/Ae}{Cb/Ab}$$

Where

LQ = Location quotient

C_e = Count of crime occurring in sub-area (environ)

A_e = Area of sub-area (environ)

C_b = Count of crime occurring in study area (street buffer)

A_b = Area of study area (street buffer)

Location quotients provide a simple way to interpret crime concentration in a specific sub-area. However, there are limitations to this method. As LQs measure crime in a defined area, the level of aggregation can greatly impact the results. This is known as the modifiable area unit problem (MAUP) where results or patterns can differ based on the unit of aggregation (Openshaw, 1984). Related to this, when crimes are aggregated to areas where these events are unlikely to occur or be recorded, this can affect the accuracy of this rate-based calculation (Wuschke et al., 2021a). In Portland, for instance, police records of crime events are aggregated at block-level addresses along the street network; therefore, using the entire city area to standardize this rate is inaccurate, as much of this space will not be associated with any crime at all. Rate calculations will be artificially lower when standardized by this larger-than-accurate area.

Prior studies that have examined crime at and around parks have used LQs, applying Euclidean buffers to create the "park environs" that capture crime events in the area around the park (Groff & McCord, 2011; McCord & Houser, 2017). The buffer-based environs capture all area within a specific distance from the park space (for example, the surrounding 60 feet). This buffer, however, also captures areas where crimes are typically not recorded by police departments and can therefore also lead to misleading rate calculations when used.

In a recent study, Wuschke and colleagues presented a modified version of the LQ method which aggregated crime to the street block rather than relying on a traditional Euclidean buffer. This method ensured that areas where crime could not occur (or be recorded) were not included in the analysis (Wuschke et al., 2021a). Such network-based approaches work well with detailed, address-level crime data, allowing for consistent

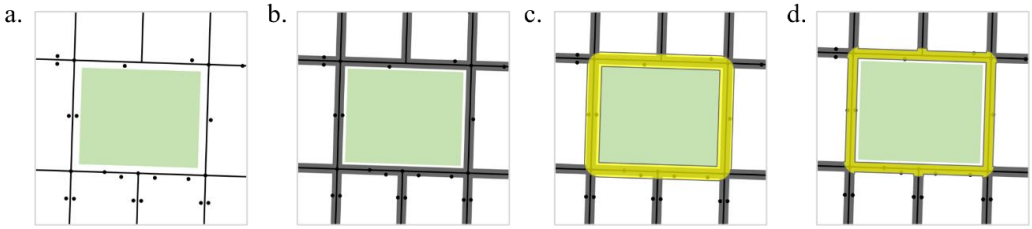
connections between crime events and the street segment on which they occurred. However, publicly available crime data (such as that provided by PPB) is often not available at the address-level but is aggregated to the nearest intersection or block midpoint in order to protect the privacy of those involved. With a high volume of events aggregated to intersections, the street segment may not be the best unit of analysis for such public records.

Measuring Crime Concentration in Park Environs. This research uses a hybrid methodology, proposed in a related study, which addresses the area inflation typically seen with traditional Euclidean buffers, while accepting the less precise, publicly-accessible crime data sources that are increasingly becoming the norm (Wuschke et al., 2021b). Through the use of a Euclidean buffer around the Portland street network, this study captures all geographic space within the city where crime would typically be reported within PPB public records (figure 3-1a). Shown in figure 3-1b, this buffer allows for the reported crime points to fall within it, while excluding areas where these crime points would not typically be recorded. A distance of 40 feet (20 feet on each side) was used to capture the majority of crime points while limiting the total area as much as possible.

The street buffer formed the adapted study area and was used as the LQ denominator's area (A_b). The total area of the city of Portland was 4,049,211,040.5 square feet while the area of the street buffer was 535,541,364.8 square feet. This resulted in 86.4% of the overall area being removed, the vast majority of which has no reported crime within PPB records. A small number of events which do not follow typical reporting practices fell outside of this street buffer and were excluded from the analyses (2,988 crime events, or 1.9%). This could be due to events being recorded along unofficial streets or at

specific locations. This resulted in 205,628 events included. In addition to the "all crime" category, nine individual crime types were included in the analyses: theft from motor vehicles (n = 39,569), motor vehicle theft (MVT) (n = 25,310), vandalism (n = 22,465), robbery (n = 3,657), simple assault (n = 8,601), intimidation, aggravated assault, drug and narcotic violations, and weapon law violations.

Figure 3-1. Process of Creating Street Buffers and Park Environs



In order to capture the crime events around parks, additional buffers were created to act as the "environs" (Groff & McCord, 2011). The *environ* refers to the 60-foot area around the parks, used for two reasons: (1) to capture crime events that are recorded to the streets surrounding parks (as the crime data's anonymization process makes it impossible to distinguish from crimes occurring inside and outside of the park), and (2) to act as the situational backcloth, capturing the area directly outside of the park which may be influenced by its presence (Groff & McCord, 2011). These buffers were designed to include the streets and intersections immediately surrounding the parks, as well as the crime recorded in these areas. To do so, a 60-foot distance was needed. This buffer was then clipped to the Portland area street buffer, to ensure that area not captured in the street buffer (LQ denominator) was removed from the environs (LQ numerators). This removes the park area from the calculations as well, as the crime events are only recorded along the street. Figure 3-1c and 3-1d illustrates this process as well as the result. In figure 3-1c, the

traditional Euclidean buffer is shown, while in figure 3-1d, it is clipped to the street segment. While this is a small difference, it erased any area that was not captured within the street segment as well.

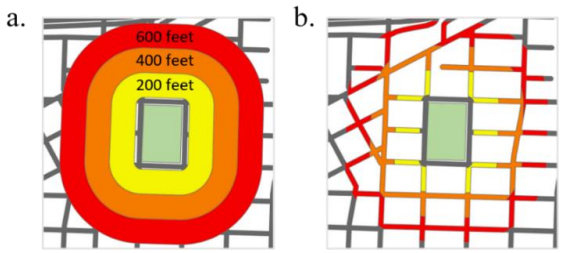
During this process, two parks had to be excluded (Pettygrove Park and Lovejoy Fountain). These two parks are small plazas lying within city blocks, surrounded by buildings (shown in figure 3-2). Therefore, the buffers surrounding these parks could not be clipped to the nearest street buffer. This resulted in a total of 102 parks included in the final analyses. These parks were analyzed both as a collective unit and individually.

Figure 3-2. Pettygrove Park and Lovejoy Fountain, excluded from analyses

Measuring Crime Concentration in Areas Surrounding Parks. To capture the concentration of crime as distance from the park increased, three ring buffers were created around the environ buffer at 200-foot intervals (200 feet, 400 feet, 600 feet). This distance was chosen as this is the average length of a city block in Portland, thus the buffers approximate a three-block radius surrounding each park (Miskimins, 2017). As with the environ, the Euclidean buffers were clipped to the street network buffers. This process can be seen in figure 3-3a and b, which show the initial Euclidean buffer, capturing all area within the specified distances, and the clipped buffers that exclude this unnecessary area.

Once the environ and buffers were created and clipped spatial joins were used to collect a count of each crime type occurring in the various buffer areas.

Figure 3-3. Multiple Ring Park Buffers



Exploring Park Characteristics. The surrounding zoning for each park was classified using zoning data from Portland Maps, which contains detailed information about the different land use zone codes (n = 21). These were grouped into six simplified zoning categories: commercial, residential, mixed-use, employment, industrial, and open space (detailed information on the coding process can be found in the appendix). Open space zoning was excluded as this aligned with the zoning of the parks themselves, leaving five land use types. The zoning data was joined to the park environs in ArcGIS to calculate the percentage of each zone within the environ space. Guided by the work of Groff & McCord (2011), the percentages were then used to categorize the environs into one of three land use groupings: (1) exclusively residential, where 100% of the surrounding land use was classified as residential; (2) majority residential – mixed use, where at least 50% was residential with the rest being mixed use; and (3) non-residential, where there was less than 50% residential zoning.

In order to consider how features in and around parks may impact nearby crime, park attribute data were analyzed within SPSS. This dataset includes the park name, size, and type, as well as a 0 or 1 coded for each of the amenities (n = 16), and the land use

grouping of the park. Amenities were selected based on those included in prior park studies as well as a theoretical basis. These include elements of the physical park environment, which may define and limit the use of the space, as well as draw people in for different reasons (Groff & McCord, 2011; McCord & Houser, 2017). The amenities that were included in the analysis were broken up into two groupings: (1) park characteristics, which included paved paths, unpaved paths, statues or public art, water features/fountains, and plazas; and (2) activity generators, which included playground/play area, picnic shelter/table, basketball court, soccer field, softball field, dog off-leash area, tennis court, baseball field, volleyball court, skating area, and bocce court.

In SPSS, t-tests were used to test the association between the different amenities and park crime, as the amenities variable was dichotomous. T-tests were conducted for all crime as a combined category, as well as for each individual crime type. Initially, an analysis of variance test (ANOVA) was planned to be used to test the association between surrounding zoning and park crime, however, the assumption of equal variance between the land use groups (i.e., the variance of crime) was violated (these results can be found in the appendix). As this was violated (with the Levene's test coming back as significant), the Kruskal-Wallis (KW) Test was used. This is a nonparametric test that is seen as an alternative to ANOVAs in cases where the assumptions of the ANOVA are violated because it does not assume normality in the data and is much less sensitive to outliers (Laerd Statistics, 2022). KW tests were conducted for all crime as well as the individual crime types.

Results

Descriptive Statistics

Figure 3-4 shows a map of the small parks in Portland. A total of 102 parks are included in this study, all of which are classified as parks by the City of Portland and are smaller than, or equal to 10 acres in size.

Figure 3-4. Map of Small Parks in Portland

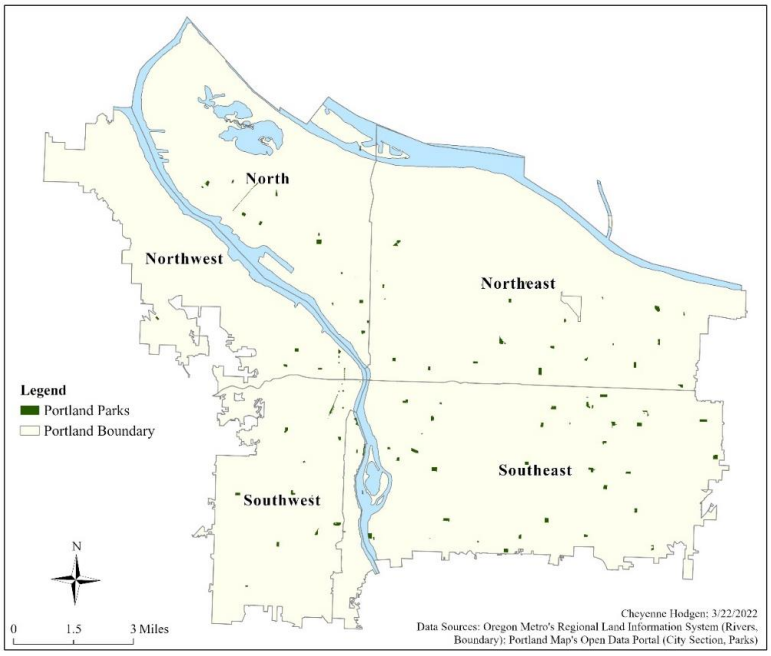


Table 3-1 provides a breakdown of park according to location within the city, the surrounding zoning, and park amenities. Of the 102 parks, 57 (55.9%) are classified as exclusively residential. Twenty parks (19.6%) are classified as majority residential – mixed use, and 25 parks (24.5%) are classified as non-residential, with 9 of these being entirely commercial zoning (8.8%). The most common park feature within this dataset is paved paths, present in 65.7% of parks; the most activity generators are playgrounds or play areas, which are present in 69.9% of parks and picnic tables or shelters, which are present in

56.9% of parks. The least common feature are plazas (present in 14.7% of parks), and the least common activity generators are skating areas and bocce courts (present in 2.9% and 2.0% of parks, respectively).

Table 3-1. Portland Park Descriptives

Park Characteristics	***f***	**%**
Park Location (City Section)		
Downtown	17	16.7%
East	23	22.5%
Southeast	22	21.6%
Northeast	17	16.7%
Southwest	11	10.8%
Northwest	1	1.0%
North	11	10.8%
Surrounding Zoning (Group)		
Exclusively Residential	57	55.9%
Majority Residential - Mixed Use	20	19.6%
Non-Residential	25	24.5%
Park Features		
Paved Paths	67	65.7%
Statue or Public Art	29	28.4%
Unpaved Paths	27	26.5%
Water Features/Fountains	20	19.6%
Plaza	15	14.7%
Activity Generators		
Playground/Play Area	71	69.6%
Picnic Shelter/Picnic Table	58	56.9%
Basketball Court	29	28.4%
Soccer Field	29	28.4%
Softball Field	27	26.5%
Dog Off-Leash Area	12	11.8%
Tennis Court	12	11.8%
Baseball Field	7	6.9%
Volleyball Court	6	5.9%
Skating Area	3	2.9%
Bocce Court	2	2.0%

RQ1: Do crime events concentrate in and around parks within Portland?

Between 2016 and 2019, there were a total of 205,628 crime events recorded within the Portland study area. Of these, 3,781 occurred within the environ of small parks (1.8%). This translates to an overall LQ for total crime of 2.1, suggesting that aggregate crime is twice as concentrated around small parks than the rest of the city. Breaking this down into specific crime types results in different levels of concentration. Shown in table 3-2, only one crime type—motor vehicle theft—has an LQ below 2.0 (1.1), suggesting that this crime type has a similar concentration around parks as compared to the city as a whole. The other eight crime types concentrate at rates of 2.0 or more times higher than compared to the city as a whole.

Table 3-2. Crime Concentration around Portland Parks

	Street Buffer Count	Environ Count	% of total	LQ
All Crime	205,628	3,781	1.8%	2.1
Theft from Motor Vehicle	39,569	780	2.0%	2.2
Motor Vehicle Theft	25,310	252	1.0%	1.1
Vandalism	22,465	468	2.1%	2.3
Simple Assault	8,601	310	3.6%	4.1
Drug/Narcotic Violations	6,548	249	3.8%	4.3
Aggravated Assault	4,591	141	3.1%	3.5
Robbery	3,657	118	3.2%	3.6
Intimidation	3,279	95	2.9%	3.3
Weapon Law Violations	2,007	68	3.4%	3.8

Next, the concentration of crime in the areas around parks was examined. Shown in table 3-3, total crime, as well as the different crime types, all appear to have a non-linear trend when moving away from the park. All crime, which has an environ LQ of 2.1, drops below the threshold in the first (200-foot) buffer (LQ of 1.4), but rises again to 2.0 in the

second (400-foot) buffer, before falling again in the final (600-foot) buffer (LQ of 1.5). This pattern changes when we break down different crime types, although most concentrate above the 2.0 threshold at 400-feet, before dropping again further away from the park. A couple crime types (simple assault, drug and narcotic violations, aggravated assault, and intimidation) concentrate above the 2.0 threshold at 600-feet as well.

Table 3-3. Crime Concentration by Distance from Park

	Environ		200ft Buffer		400ft Buffer		600ft Buffer	
	Count	**LQ**	**Count**	**LQ**	**Count**	**LQ**	**Count**	**LQ**
All Crime	3,781	2.1	4,965	1.4	12,131	2.0	11,009	1.5
Theft from Motor Vehicle	780	2.2	889	1.3	2,270	2.0	2,018	1.4
Motor Vehicle Theft	252	1.1	444	1.0	1,075	1.5	1,138	1.3
Vandalism	468	2.3	541	1.4	1,292	2.0	1,247	1.6
Simple Assault	310	4.1	245	1.7	750	3.0	670	2.2
Drug/Narcotic Violations	249	4.3	302	2.7	462	2.4	790	3.4
Aggravated Assault	141	3.5	150	1.9	294	2.2	326	2.0
Robbery	118	3.6	98	1.6	274	2.6	214	1.6
Intimidation	95	3.3	109	2.0	259	2.7	278	2.4
Weapon Law Violations	68	3.8	61	1.8	109	1.9	117	1.6

RQ2: Do some Portland parks behave as risky facilities, displaying higher concentrations of crime?

As a general category, a variety of crime types concentrate at and near small parks. It is important to determine whether this trend is uniform across all small parks, or whether there are a few "risky" parks that account for this trend. Overall, 96 parks experienced at least one criminal event between 2016 and 2019 (94.1%), while 6 parks had no crime (5.9%). Of the remaining 96 parks with crime, 16 parks (15.7%) account for 2,836 (75.0%) events. The top five parks with the highest counts of crime within their environs account for 53.7% (2,029) of events; the single park with the highest crime count (South Park

Blocks) accounts for 18.5% (701) of events. This suggests that criminal events are highly concentrated around specific Portland parks. LQs provide a meaningful way to measure this concentration: 60 parks have at least one criminal event but an LQ below 1.0 (58.8%), indicating lower crime within these locations compared to the study area as a whole. An additional 36 parks have an LQ above 1.0; 17 of which have an LQ above 2.0 (16.7% of all small parks in Portland), suggesting that crime concentrates around these parks.

Looking at specific crime types, table 3-4 displays a breakdown of each crime type as well as the number, and percentage of parks that have experienced at least one event. Three crime types appear to be highly concentrated, including weapon law violations, robbery, and intimidation events. This means that these crime types concentrate heavily in a smaller number of parks, while more prevalent crime types (including theft from motor vehicles, vandalism, and motor vehicle theft) tend to occur near most small parks.

Table 3-4. Concentration of Crime Types at Portland Parks

	Crime events within park environs	**Parks with at least one crime event**	
	f	***f***	**%**
All Crime	3,781	96	94.1%
Theft from Motor Vehicle	780	74	72.5%
Vandalism	468	74	72.5%
Motor Vehicle Theft	252	62	60.8%
Drug/Narcotic Violations	249	42	41.2%
Simple Assault	310	40	39.2%
Aggravated Assault	141	36	35.3%
Robbery	118	29	28.4%
Intimidation	95	29	28.4%
Weapon Law Violations	68	27	26.5%

Next, the ten parks with the highest crime counts were selected for a more in-depth analysis of the events occurring within these spaces. Table 3-5 and 3-6 show the results of

this analysis. These ten parks account for 2,519 (66.6%) of the criminal events occurring around parks and all but one—McCoy park—experience a concentration of all crime within the park environ.

There is considerable variation between the counts and concentration of different crime types within these parks. Four crime types: aggravated assault, simple assault, vandalism, and weapon law violations, concentrate around all ten of the parks (LQ above 2.0). Intimidation, robbery, and drug/narcotic incidents concentrate around all but one park (McCoy), and theft from motor vehicle incidents and motor vehicle theft also concentrate around most parks. This indicates that even in high crime parks, there is crime-type specialization, and they may not be high crime parks for certain crime types.

Table 3-5a. Top 10 Parks by Crime Type - All Crime and Person Crimes

	All Crime	**Aggravated Assault**	**Simple Assault**	**Intimidation**
	***f* (LQ)**	***f* (LQ)**	***f* (LQ)**	***f* (LQ)**
South Park Blocks	701 (7.0)	19 (8.5)	43 (10.3)	19 (11.9)
Pioneer Courthouse Square	488 (30.6)	15 (42.2)	61 (91.6)	22 (86.6)
North Park Blocks	383 (5.7)	18 (12.0)	38 (13.5)	6 (5.6)
Holladay Park	268 (8.8)	18 (26.4)	61 (47.8)	7 (14.4)
Couch Park	189 (8.2)	4 (7.8)	2 (2.1)	2 (5.5)
O Bryant Square	136 (10.4)	4 (13.7)	11 (20.0)	1 (4.8)
Montavilla Park	117 (3.9)	6 (8.9)	10 (7.9)	4 (8.3)
Simon and Helen Director Park	87 (6.7)	4 (13.8)	4 (7.3)	2 (9.6)
Dawson Park	83 (3.7)	3 (6.0)	10 (10.7)	2 (5.6)
McCoy Park	67 (1.8)	4 (4.9)	3 (2.0)	1 (1.7)

Table 3-5b. Top 10 Parks by Crime Type – Property and Society Crimes

	Vandalism *f* (LQ)	Theft from MV *f* (LQ)	Robbery *f* (LQ)	Motor Vehicle Theft *f* (LQ)	Drug/Narc Violation *f* (LQ)	Weapon Law Violation *f* (LQ)
South Park Blocks	81 (7.4)	207 (10.8)	16 (9.0)	40 (3.3)	33 (10.4)	7 (7.2)
Pioneer Courthouse Square	21 (12.1)	7 (2.3)	11 (38.8)	2 (1.0)	19 (37.5)	6 (38.6)
North Park Blocks	49 (6.7)	86 (6.6)	7 (5.9)	14 (1.7)	66 (30.8)	7 (10.7)
Holladay Park	13 (3.9)	19 (3.2)	38 (70.1)	8 (2.1)	21 (21.6)	12 (40.3)
Couch Park	30 (12.0)	97 (22.0)	2 (4.9)	12 (4.3)	11 (15.1)	1 (4.5)
O Bryant Square	27 (18.8)	55 (21.8)	1 (4.3)	6 (3.7)	4 (9.6)	1 (7.8)
Montavilla Park	13 (3.9)	7 (1.2)	6 (11.1)	9 (2.4)	10 (10.4)	4 (13.5)
Simon and Helen Director Park	12 (8.4)	22 (8.8)	4 (17.3)	3 (1.9)	5 (12.1)	1 (7.9)
Dawson Park	13 (5.3)	7 (1.6)	3 (7.6)	7 (2.6)	15 (21.1)	5 (23.0)
McCoy Park	13 (3.2)	6 (0.9)	0 (0.0)	15 (3.3)	2 (1.7)	4 (11.2)

RQ3: Is there an association between the amenities present at parks and crime concentration?

Next, t-tests were conducted to compare the mean of crime at parks with and without different amenities. Table 3-6 shows the results of this analysis for all crime at parks. Of the 16 amenities included in the analysis, six are significantly associated to the overall crime category. There are positive associations between crime and the presence of: statues or public art, water features or fountains, and plazas, and negative associations between unpaved paths, soccer fields, and softball fields.

Table 3-6. All-Crime Amenity T-test Results

	N	Mean without amenity	Mean with amenity	t-value	*p*
Park Features					
Paved Paths	67	29.8	40.9	-0.549	0.292
Statue or Public Art**	29	12.3	99.4	-2.853	0.004
Unpaved Paths*	27	45.5	13.7	2.344	0.011
Water Features/Fountains*	20	20.6	104.4	-2.057	0.027
Plaza*	15	18.9	142.5	-2.361	0.016
Activity Generators					
Playground/Play Area	71	44.0	34.0	0.480	0.316
Picnic Shelter/Picnic Table	58	55.2	23.3	1.486	0.072
Basketball Court	29	36.4	38.9	-0.118	0.453
Soccer Field*	29	45.2	16.6	2.080	0.020
Softball Field*	27	43.5	19.1	1.795	0.038
Dog Off-Leash Area	12	38.6	25.6	0.44	0.331
Tennis Court	12	39.5	19.2	0.686	0.247
Baseball Field	7	38.1	23.3	0.392	0.348
Volleyball Court	6	36.6	44.5	-0.195	0.423
Skating Area	3	37.6	19.3	0.323	0.374
Bocce Court	2	33.9	195.5	-0.861	0.273

One-sided significance: * $p < 0.05$, ** $p < 0.01$

T-tests were then conducted for each crime type and amenity (tables in appendix). Regarding park features, the presence of paved paths is significantly associated with higher motor vehicle theft incidents while the presence of unpaved paths is significantly associated with lower mean crime for aggravated assault, simple assault, and theft from motor vehicle incidents. The presence of statues or public art is significantly associated with higher crime for all crime types, the presence of water features or fountains is significantly associated with higher crime for all but two crime types (theft from motor vehicles and motor vehicle theft), and the presence of plazas is significantly associated with higher crime for all but two crime types (robbery and motor vehicle theft).

Looking at in-park activity generators, only two have significant associations with different crime types. Soccer fields are significantly associated with lower mean aggravated assault, simple assault, theft from motor vehicle, and drug/narcotic violation incidents. Lastly, the presence of softball fields is significantly associated with lower mean aggravated assault and simple assault incidents. Although not reaching a significant p-value, picnic tables and shelters came close ($p = 0.072$), and a negative association was found with the presence of picnic tables/shelters being associated with lower crime. This suggests that the presence of different amenities at parks are associated with higher, or lower, levels of specific crime types, but not others.

RQ4: Is there an association between surrounding land use and crime at/near parks?

Lastly, this study investigates the association between the surrounding land use zoning and the level of crime within the park environ. Table 3-7 presents the mean comparisons between the three land use categories, as well as the reported significance of the Kruskal-Wallis tests. The null hypothesis—that the distribution of crime across the zoning categories is uniform—is rejected for all crime as well as each crime type. For all crime, parks with surrounding land use classified as exclusively residential have a mean of 9.6 crime events. Those classified as majority residential – mixed use have a mean of 24.45 events, while those classified as non-residential have a mean of 108.60 events. This trend is the same for each of the crime types, with exclusively residential land use being associated with lower crime and non-residential being associated with higher crime.

Table 3-7. Surrounding Land Use Means Comparison and Kruskal-Wallis Test

	Exclusively Residential (n = 55)	Majority Residential - Mixed Use (n = 22)	Non-Residential (n = 25)
All Crime***	9.60	24.45	108.60
Aggravated Assault***	0.35	0.77	4.20
Simple Assault***	0.36	0.86	10.84
Intimidation**	0.24	0.32	3.00
Vandalism***	1.56	3.77	11.96
Theft from Motor Vehicle**	1.82	7.14	20.92
Robbery**	0.25	0.55	3.68
Motor Vehicle Theft**	1.20	2.95	4.84
Drug/Narcotic Violation***	0.45	1.41	7.72
Weapon Law Violation***	0.16	0.41	2.00

* $p < 0.05$, ** $p < 0.01$, ***$p<0.001$

The Kruskal-Wallis tests also reports the pairwise comparisons between categories, thus allowing for the examination of whether there is a significant difference between each category. Table 3-8 reports the results of those tests. Examining comparisons between exclusively residential and majority residential – mixed use land use categories, there is no significant difference in the level of crime for any crime types. When looking at the difference between exclusively residential and non-residential, however, there is a significant difference between all crime types. Lastly, looking at the difference between majority residential – mixed use and non-residential, there is a significant difference for all crime, simple assault, intimidation, vandalism, and theft from motor vehicle incidents. These findings indicate that, within Portland, parks surrounded by residential and mixed zoning contain significantly less crime than those surrounded by non-residential zoning.

Table 3-8. Pairwise Comparisons Between Land Use Categories

	Between Exclusively Residential and Majority Residential - Mixed Use	Between Exclusively Residential and Non-Residential	Between Majority Residential - Mixed Use and Non-Residential
All Crime	0.904	0.000***	0.010**
Aggravated Assault	0.465	0.000***	0.090
Simple Assault	0.602	0.000***	0.001**
Intimidation	1.000	0.002**	0.028*
Vandalism	1.000	0.000***	0.004**
Theft from Motor Vehicle	1.000	0.002**	0.020*
Robbery	0.404	0.003**	0.452
Motor Vehicle Theft	0.651	0.002**	0.227
Drug/Narcotic Violation	0.279	0.000***	0.073
Weapon Law Violation	0.839	0.000***	0.066

* $p < 0.05$, ** $p < 0.01$, ***$p<0.001$

a. Significance values have been adjusted by the Bonferroni correction for multiple tests.

Discussion

Criminological theories conflict regarding whether parks are criminogenic or protective factors within the built urban environment. Studies on parks and crime have illustrated this conflict, finding varying patterns and results. The goal of this study was to contribute to the growing literature on parks and crime by examining this relationship in the city of Portland, Oregon. This study was broken down into four research questions, aiming to examine crime concentration around parks, explore the impact of amenities and surrounding land use zoning, as well as the patterns of concentration in areas beyond the parks. From the results of this study, there are five key themes that emerge.

First, these findings suggest that aggregate crime, as well as the majority of crime types, do concentrate around small parks in Portland, answering RQ 1. Aggregate crime was twice as concentrated around these locations compared to the rest of the reportable

area, which is consistent with the findings of prior examinations of parks in Philadelphia and Louisville (Groff & McCord, 2011; McCord & Houser, 2017). The level of crime concentration in a 3-block radius from the park environ was also examined. As was found in Groff and McCord's study, there was a non-linear pattern in concentration as distance from the park increased. Groff and McCord suggest that one possible reason for this could be because residents in the blocks surrounding the park could be more aware of the issues related to the park and therefore take steps to prevent it from impacting their streets (Groff & McCord, 2011). Whether this is evidence of crime displacement or crime detracting in areas immediately surrounding parks is worth examining in future research.

Second, when specific crime types were examined, all but one (motor vehicle theft) were found to concentrate around parks, although the exact level of concentration varied. Drug/narcotic violations and simple assaults had the highest levels of concentration, which could be due to the opportunities present at park locations. For instance, drug/narcotic violations may be more concentrated because parks provide a space for drug use and sales, while simple assaults may be more concentrated due to the number of people present that provide targets for these direct-predatory crimes. Interestingly, while motor vehicle theft was not found to concentrate around park locations, it is unlikely that this is due to an absence of targets, as thefts from motor vehicles were found to concentrate around parks. This could suggest that while thefts from motor vehicles occur, the presence of people at the park (i.e., guardianship) prevents the more obvious crime of motor vehicle thefts from occurring. This is an area that warrants further study as it suggests that parks may not provide the necessary environment for certain crimes but seem to provide a suitable environment for other types. These findings support the work of Andresen and Linning,

who emphasize that disaggregating crime types is imperative if we are to better understand where crime occurs (Andresen & Linning, 2012).

Third, this study found that while the vast majority of parks experienced at least one crime event (94.1%), only a small number of these locations were found to have a concentration of crime, or LQ above 2.0 (16.7%). This answers RQ 2, suggesting that most small parks in Portland do not experience a concentration of crime and that there are a small number of "risky" park locations. In this study, the park with the highest crime, the South Park Blocks, accounted for 18.5% (701) of all the events occurring around these locales. This result contrasts with that of Groff and McCord, who found that the majority of Philadelphia parks experienced a concentration of crime (Groff & McCord, 2011). The finding of this study supports the risky facilities framework, where a small proportion of locations, in this case parks, account for the majority of crime (Eck et al., 2007). This finding may suggest that the concentration of crime around parks in Portland is not driven by the parks themselves but may be associated with the unique features or opportunities present at the high crime parks themselves. In some cases, the high crime levels seen around these specific locations could be due to other factors, such as protests—which have risen in prevalence over the study time-frame. Further investigation within this area will be useful to inform crime prevention strategies specific to these high crime locales.

Fourth, the presence of different amenities at parks has been examined in prior studies, with different amenities appearing to be associated with crime in different locations (Groff & McCord, 2011; McCord & Houser, 2017). In response to RQ 3, three Portland park features were identified as being associated with higher levels of crime: statues and public art, water features or fountains, and plazas. In addition, three features were found to

be associated with lower levels of crime: unpaved paths, soccer fields, and softball fields. These results also varied slightly by crime type, suggesting that the presence of certain features may impact some crime types but not others. Regarding the features associated with higher crime, there is the possibility that these features facilitate an environment that is more prone to crime, or perhaps act as targets themselves. This finding may also be related to the location of the park within the city. Parks with these features (e.g., plazas) may be more common in some areas of Portland, such as within the downtown core, and less common within residential neighborhoods.

Concerning potentially protective elements, the presence of unpaved paths may be a deterrent in itself, limiting modes of access to the park space. It could also indicate that the space is used for hiking or dog walking, bringing the subsequent presence of guardians to deter potential offenders from these spaces. Regarding the sports amenities, prior studies have found similar results in that they are associated with reduced levels of crime (Groff & McCord, 2011; McCord & Houser, 2017). The presence of a sports field could indicate greater use of the park, increasing the number of guardians in the space. Further, as Groff and McCord suggest, the presence of these spaces could indicate an element of territoriality where the space is used by sports clubs or schools, again increasing the levels of guardianship.

Fifth, in addition to what is inside the park, this study also found that the area around the park was associated with differential crime levels. In response to RQ 4, the key finding of this analysis is the impact of residential zoning in the areas surrounding Portland parks. Parks surrounded by exclusively residential, or majority residential, zoning were associated with the lowest crime levels. This contrasts with the findings of Groff and McCord (2011),

who found that parks surrounded by residential use had higher crime. While Portland parks surrounded by mixed-land use (majority residential) still experienced low crime levels, parks surrounded by exclusively residential area had the lowest levels. There are a number of reasons for this relationship. Residents may act as active guardians within nearby park spaces, allowing for easy identification of outsiders by regular park users. This guardianship may deter potential offenders from committing crimes due to an increased risk. Further, these parks, by virtue of being surrounded by residential area, may be less frequented by outsiders because they are not nearby any other public establishment(s). Lastly, it is possible that the location of these parks within the city (the broader context) is important. Perhaps parks surrounded by exclusively residential or mixed-use are less likely to be in the downtown area, and the resulting association is again an indirect link to park location.

Limitations and Future Directions

While this study answered some important questions about the relationship between crime and parks in Portland, several limitations can be addressed by future studies. This study set off to apply an improved method for calculating location quotients by adapting buffers to avoid capturing area where crime does not occur (or is not reported). While this method is an improvement over the traditional Euclidean buffer, there are two things worth mentioning. First, while the LQ provides a strong and simple way to measure crime concentration, there is still the concern of rate inflation, as was seen in several instances where crime counts were relatively low but due to the small environ area, the LQ was high. Second, while these buffers excluded all areas where PPB does not record crime, they were

able to capture street segments that were not physically connected to the location. For example, a dead-end street that falls within the 60ft environ would be clipped and included in the environ area. Further, this study only used one method (LQs) to determine whether crime concentrates at and near parks. Thus, it did not use further parametric comparisons to assess the statistical significance of these relationships.

Regarding research questions 3 and 4, the analyses were limited by the small sample (n = 102) as well as the presence of a few outlier parks (high crime) which could skew the results of the T-tests and KW tests. It is worth noting too that, of the top 10 parks (based on crime count), seven of these were in the downtown area, suggesting that the location of the park may be an important factor to consider. Additionally, some of the amenities were only present at a couple of parks, meaning that these findings may not be generalizable to that amenity outside of this study.

This study was the first to examine the concentration of crime in and near Portland parks and serves as a necessary precursor to further studies. Due to its exploratory nature, this study did not consider the effect of the park location (within the city), nor did it consider the effect of neighborhood characteristics (such as poverty or social disadvantage). Both of these factors could influence the presence of crime at parks and thus future research needs to examine this. Finally, this study doesn't consider the potential temporal variation of crime patterns (Andresen & Linning, 2012). Certain crimes may be more likely to occur at specific times, thus this is something that should be considered in future research.

Conclusion

The goal of this study was to examine the relationship between small parks and crime in Portland, Oregon. Using an adapted street buffer method as an improved way to measure crime concentration, the results found that crime does appear to concentrate around small parks. The level of the concentration, however, varied by crime type illustrating the importance of disaggregating crime types in spatial analyses. Further, this study examined the effect of park amenities and the surrounding land use zoning on crime, finding that these factors may influence the concentration of crime at and near park locations. Positive associations with crime were found between statues/public art, water features/fountains, and plazas, while negative associations were found between unpaved paths, soccer fields, and softball fields. Parks surrounded by majority or exclusively residential land use zoning had lower levels of crime. These results highlight the locally-specific factors that may be related to crime at parks and highlight future avenues for research. In Portland specifically, the high-crime parks identified, as well as associations between crime and park features and zoning, are important factors for the city to consider when allocating and determining funding for park improvements. More research is needed to further our understanding of this relationship and should consider park location, neighborhood characteristics, and temporal factors, as they relate to crime at and near parks.

Appendix

Table 3-9. Land Use Type Coding

Code (number)	Categories Included
Commercial (2)	Central Commercial
Residential (3)	Single – Dwelling 10,000; Single – Dwelling 2,500; Single – Dwelling 20,000; Single – Dwelling 5,000; Single – Dwelling Residential Farm/Forest; Central Residential; Multi-Dwelling – Corridor; Multi-Dwelling – Neighborhood; Multi-Dwelling – Urban Center; Manufactured Dwelling Park
Mixed Use (4)	Mixed Use – Civic Corridor; Mixed Use – Dispersed; Mixed Use – Neighborhood; Mixed Use – Urban Center; Mixed Employment; Institutional Campus
Employment (5)	Central Employment
Industrial (6)	Industrial Sanctuary
Open Space (1)	Open Space

Table 3-10. Amenity T-Test Results

Dog Off-Leash Area	Mean without (n = 90)	Mean with (n = 12)	T-value	*P*
Aggravated Assault	1.5	0.5	0.924	0.179
Simple Assault	3.38	0.5	0.924	0.179
Intimidation	1	0.42	0.619	0.269
Vandalism	4.68	3.92	0.238	0.406
Theft from Motor Vehicle	7.19	11.08	-0.515	0.304
Robbery	1.24	0.5	0.563	0.287
Motor Vehicle Theft	2.54	1.92	0.428	0.335
Drug/Narcotic Violation	2.64	0.92	0.71	0.24
Weapon Law Violation	0.73	0.17	1.038	0.151
Playground/Play Area	Mean without (n = 31)	Mean with (n = 71)	T-value	*P*
Aggravated Assault	1.94	1.14	1.050	0.148
Simple Assault	5.39	2.01	1.194	0.120
Intimidation	1.39	0.73	0.996	0.161
Vandalism	3.84	4.92	-0.481	0.316
Theft from Motor Vehicle	6.29	8.24	-0.367	0.357
Robbery	1.94	0.82	0.869	0.196
Motor Vehicle Theft	1.97	2.69	-0.704	0.241
Drug/Narcotic Violation	2.26	2.52	-0.154	0.439
Weapon Law Violation	0.90	0.56	0.888	0.188
Unpaved Paths	Mean without (n = 75)	Mean with (n = 27)	T-value	*P*
Aggravated Assault	1.69	0.52	2.207	0.015
Simple Assault	3.75	1.07	1.895	0.031
Intimidation	1.11	0.44	0.966	0.168
Vandalism	5.39	2.37	1.301	0.098

Theft from Motor Vehicle	9.95	1.26	2.646	0.005
Robbery	1.39	0.52	0.902	0.185
Motor Vehicle Theft	2.87	1.37	1.410	0.081
Drug/Narcotic Violation	3.01	0.85	1.222	0.112
Weapon Law Violation	0.79	0.33	1.139	0.129
Paved Paths	Mean without (n = 35)	Mean with (n = 67)	T-value	*P*
Aggravated Assault	1.11	1.52	-0.554	0.290
Simple Assault	2.86	3.13	-0.131	0.448
Intimidation	1.03	0.88	0.231	0.409
Vandalism	2.83	5.51	-1.242	0.108
Theft from Motor Vehicle	4.77	9.15	-0.854	0.197
Robbery	0.66	1.42	-0.850	0.199
Motor Vehicle Theft	1.31	3.07	-1.795	0.038
Drug/Narcotic Violation	1.26	3.06	-1.095	0.138
Weapon Law Violation	0.40	0.81	-1.097	0.138
Picnic Shelter/Table	Mean without (n = 44)	Mean with (n = 58)	T-value	*P*
Aggravated Assault	1.98	0.93	1.398	0.084
Simple Assault	4.27	2.10	1.072	0.143
Intimidation	1.48	0.52	1.402	0.084
Vandalism	6.36	3.24	1.345	0.092
Theft from Motor Vehicle	13.20	3.43	1.769	0.042
Robbery	1.14	1.17	-0.042	0.483
Motor Vehicle Theft	2.70	2.29	0.431	0.334
Drug/Narcotic Violation	3.66	1.52	1.216	0.115
Weapon Law Violation	0.68	0.66	0.075	0.470
Plaza	Mean without (n = 87)	Mean with (n = 15)	T-value	*P*
Aggravated Assault	0.71	5.27	-2.685	0.009
Simple Assault	1.23	13.53	-2.158	0.024
Intimidation	0.36	4.27	-2.175	0.024
Vandalism	2.77	15.13	-2.321	0.018
Theft from Motor Vehicle	3.75	30.27	-1.840	0.043
Robbery	0.48	5.07	-1.735	0.052
Motor Vehicle Theft	1.80	6.33	-1.682	0.057
Drug/Narcotic Violation	1.64	7.07	-2.055	0.028
Weapon Law Violation	0.38	2.33	-2.158	0.024
Skating Area	Mean without (n = 99)	Mean with (n = 3)	T-value	*P*
Aggravated Assault	1.39	1.00	0.190	0.425
Simple Assault	3.10	1.00	0.352	0.363
Intimidation	0.95	0.33	0.343	0.366
Vandalism	4.61	4.00	0.099	0.461
Theft from Motor Vehicle	7.84	1.33	0.451	0.327
Robbery	1.18	0.33	0.336	0.369
Motor Vehicle Theft	2.52	1.00	0.542	0.294
Drug/Narcotic Violation	2.47	1.33	0.245	0.403
Weapon Law Violation	0.67	0.67	0.000	0.500
Statue or Public Art	Mean without (n = 73)	Mean with (n = 29)	T-value	*P*
Aggravated Assault	0.48	3.66	-2.896	0.004
Simple Assault	0.62	9.14	-2.600	0.007
Intimidation	0.26	2.62	-2.376	0.012
Vandalism	1.97	11.17	-2.841	0.004
Theft from Motor Vehicle	1.95	22.00	-2.511	0.009
Robbery	0.37	3.14	-1.944	0.031
Motor Vehicle Theft	1.41	5.14	-2.529	0.009

Drug/Narcotic Violation	0.70	6.83	-2.380	0.012
Weapon Law Violation	0.29	1.62	-2.384	0.012
Tennis Court	Mean without (n = 90)	Mean with (n = 12)	T-value	*P*
Aggravated Assault	1.51	0.42	1.012	0.157
Simple Assault	3.32	0.92	0.771	0.221
Intimidation	1.01	0.33	0.720	0.237
Vandalism	4.87	2.50	0.741	0.230
Theft from Motor Vehicle	7.96	5.33	0.346	0.365
Robbery	1.26	0.42	0.635	0.263
Motor Vehicle Theft	2.49	2.33	0.106	0.458
Drug/Narcotic Violation	2.67	0.75	0.788	0.216
Weapon Law Violation	0.72	0.25	0.864	0.195
Basketball Court	Mean without (n = 73)	Mean with (n = 29)	T-value	*P*
Aggravated Assault	1.38	1.38	0.005	0.498
Simple Assault	3.26	2.48	0.348	0.364
Intimidation	1.00	0.76	0.358	0.360
Vandalism	4.07	5.90	-0.802	0.212
Theft from Motor Vehicle	6.97	9.34	-0.439	0.331
Robbery	1.29	0.83	0.487	0.314
Motor Vehicle Theft	2.18	3.21	-0.986	0.163
Drug/Narcotic Violation	1.84	3.97	-1.231	0.111
Weapon Law Violation	0.66	0.69	-0.082	0.467
Volleyball Court	Mean without (n = 96)	Mean with (n = 6)	T-value	*P*
Aggravated Assault	1.35	1.83	-0.322	0.374
Simple Assault	2.99	3.83	-0.197	0.422
Intimidation	0.93	1.00	-0.056	0.478
Vandalism	4.40	7.67	-0.748	0.228
Theft from Motor Vehicle	7.75	6.00	0.169	0.433
Robbery	1.15	1.33	-0.103	0.459
Motor Vehicle Theft	2.39	3.83	-0.722	0.236
Drug/Narcotic Violation	2.35	3.83	-0.443	0.329
Weapon Law Violation	0.61	1.50	-1.187	0.119
Bocce Court	Mean without (n = 100)	Mean with (n = 2)	T-value	*P*
Aggravated Assault	1.23	9.00	-0.863	0.273
Simple Assault	2.72	19.00	-0.856	0.274
Intimidation	0.89	3.00	-0.967	0.168
Vandalism	4.17	25.50	-0.907	0.265
Theft from Motor Vehicle	6.91	44.50	-0.904	0.266
Robbery	1.11	3.50	-0.779	0.219
Motor Vehicle Theft	2.37	7.50	-1.521	0.066
Drug/Narcotic Violation	1.82	33.50	-0.975	0.254
Weapon Law Violation	0.61	3.50	-0.825	0.280
Soccer Field	Mean without (n = 73)	Mean with (n = 29)	T-value	*P*
Aggravated Assault	1.73	0.52	2.263	0.013
Simple Assault	3.92	0.83	2.156	0.017
Intimidation	1.12	0.45	1.007	0.158
Vandalism	5.27	2.86	1.061	0.146
Theft from Motor Vehicle	9.45	3.10	1.829	0.036
Robbery	1.30	0.79	0.538	0.296
Motor Vehicle Theft	2.85	1.52	1.281	0.102
Drug/Narcotic Violation	3.12	0.72	2.117	0.019
Weapon Law Violation	0.81	0.31	1.281	0.102
Softball Field	Mean without (n = 75)	Mean with (n = 27)	T-value	*P*

Aggravated Assault	1.71	0.48	2.355	0.010
Simple Assault	3.75	1.07	1.896	0.031
Intimidation	1.08	0.52	0.818	0.208
Vandalism	5.20	2.89	0.993	0.161
Theft from Motor Vehicle	8.92	4.11	0.872	0.193
Robbery	1.31	0.74	0.586	0.279
Motor Vehicle Theft	2.60	2.11	0.457	0.324
Drug/Narcotic Violation	2.96	1.00	1.107	0.136
Weapon Law Violation	0.83	0.22	2.180	0.016
Baseball Field	Mean without (n = 95)	Mean with (n = 7)	T-value	*P*
Aggravated Assault	1.41	1.00	0.297	0.384
Simple Assault	3.18	1.14	0.511	0.305
Intimidation	0.98	0.29	0.578	0.282
Vandalism	4.64	3.86	0.192	0.424
Theft from Motor Vehicle	7.96	3.43	0.470	0.320
Robbery	1.19	0.71	0.282	0.389
Motor Vehicle Theft	2.49	2.14	0.188	0.426
Drug/Narcotic Violation	2.55	1.00	0.498	0.310
Weapon Law Violation	0.68	0.43	0.366	0.358
Water Features/Fountains	Mean without (n = 82)	Mean with (n = 20)	T-value	*P*
Aggravated Assault	0.76	3.95	-2.343	0.015
Simple Assault	1.20	10.60	-2.132	0.023
Intimidation	0.32	3.45	-2.272	0.017
Vandalism	3.22	10.20	-1.737	0.049
Theft from Motor Vehicle	5.21	17.65	-1.209	0.120
Robbery	0.46	4.00	-1.749	0.048
Motor Vehicle Theft	1.80	5.20	-1.677	0.055
Drug/Narcotic Violation	1.61	5.85	-1.958	0.031
Weapon Law Violation	0.33	2.05	-2.376	0.014

Table 3-11. Surrounding Land Use ANOVA Results

	Levene's Test		**ANOVA**	
	Levene Statistic (Based on Mean)	***P***	**f**	***P***
All Crime***	25.290	0.000	11.298	0.000
Aggravated Assault***	28.478	0.000	13.366	0.000
Simple Assault***	32.357	0.000	11.986	0.000
Intimidation***	22.264	0.000	8.767	0.000
Vandalism***	14.950	0.000	10.347	0.000
Theft from Motor Vehicles**	10.934	0.000	5.701	0.005
Robbery**	16.463	0.000	6.391	0.002
Motor Vehicle Theft**	7.640	0.001	5.665	0.005
Drug/Narcotic Violation***	22.049	0.000	8.645	0.000
Weapon Law Violation***	32.359	0.000	11.440	0.000

ANOVA Significance: * $p < 0.05$, ** $p < 0.01$, ***$p<0.001$

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Chapter 4: Conclusion

Greenspace and Crime

Research on the benefits of greenspaces in urban landscapes often highlights the important social and health benefits that these locations provide. Greenspaces can provide much needed areas for urban residents to get exercise and socialize. In the fields of urban studies and public health, greenspaces have been demonstrated to have a clear impact filtering air toxins and acting as a counter to the urban heat island effect (Bowler et al., 2010; Yang et al., 2005). In addition, studies have highlighted the positive effects for residents, with greenspaces being associated with strengthened place attachment and social cohesion among residents (Mason, 2010; McCunn & Gifford., 2014). The problem, however, is that criminological theories conflict on explaining whether these important locations should be protective or criminogenic. Current research on greenspaces and parks further highlights this conflict, with some finding parks to be criminogenic (Groff & McCord, 2011; Kimpton et al, 2017; McCord & Houser, 2017), while others do not (Boessen & Hipp, 2018; Breetzke et al., 2020). The presence of crime at greenspaces is problematic as it could increase fear of crime at these places, leading to avoidance by neighborhood residents, who would lose out on the numerous benefits afforded by these locations. Thus, understanding this relationship is key in forming crime prevention strategies to protect these locations.

To thoroughly examine the relationship between greenspaces and crime, this thesis uses two independent yet related studies, with the second building on the first. In the remainder of this chapter, the two studies included will be summarized. This will be

followed by a discussion of the findings of both studies, highlighting how they relate to one another and contribute to this area of research. Finally, there will be a discussion of the implications of these findings, both for Portland greenspaces and future research.

Study 1

The first study included in this thesis focused on all greenspace types in Portland, Oregon. This included natural areas, public gardens, community gardens, and parks (broken further into small and large parks). The goal of this study was to examine the relationship between the various greenspace types and different crimes, to better our understanding of the complex relationship between greenspace and crime. This study used a modified street-buffer method which improved the measurement of location quotients (crime concentration) around the greenspaces. By using the street buffer rather than the entire city area in the analysis, only areas where crime were recorded by the Portland Police were included, which aimed to address the problem of rate inflation. The study found that overall, crime did not appear to concentrate around greenspaces in Portland, however, this relationship changed as different greenspace types and crime types were examined. This emphasizes the importance of considering the heterogeneity between greenspace types as they will offer different opportunities that may be better for certain crime types but not others. The results suggested that, in Portland, natural areas and large parks do not experience concentration of any crime types, public and community gardens experience concentration of some, but not all, crime types, and small parks experience a concentration of all but one crime type.

Study 2

Once the first study established that crime concentrates around small parks in Portland, this study set out to further examine this relationship by looking at the park characteristics: park features, activity generators, and surrounding land use types. Additionally, this study examined the concentration of crime in areas nearby the park, beyond the environ itself. This study employed the same spatial analytical methods used in the previous study, finding that small parks report a concentration of all but one crime type (motor vehicle theft) and that the majority of crimes took place near a small proportion of "risky" parks. Further, non-linear levels of crime concentration were found in the blocks surrounding small parks. The presence of certain park features, including statues and public art and plazas, were generally associated with higher levels of crime (although this varied by crime type), while the presence of certain activity generators, including soccer fields, were generally associated with lower levels of crime, again varying by crime type. Finally, small parks surrounded by exclusively or majority residential land use had lower levels of crime, suggesting that the level of crime at and near small parks may be impacted by its surroundings.

Integration of Findings

Together, the results of the two contributions included in this thesis highlight the important findings made by Andresen and Linning (2012) and Wuschke and Kinney (2018) regarding the disaggregation of crime and place types, respectively. In Chapter 2, there was a variation in the concentration of crime around all greenspaces, as well as different types of greenspaces. Further, this crime concentration varied when examining different crime

types, suggesting that different greenspace types, which draw in users for different reasons, could offer different opportunities for different crimes. Chapter 3 took a closer look at the greenspace type identified as experiencing high levels of crime concentration in chapter 2: small parks. In chapter 3, the importance of examining different crime types was again important as park amenities and surrounding land use was considered. While the relationship between crime and surrounding land use was fairly consistent across different crime types, different park amenities appeared to be significantly associated with certain crime types, but not others.

Limitations

While the methods used in these papers are an improvement over the traditional Euclidean buffer approach, there are a few limitations worth noting. First, LQs, as a rate-based measure, are still subject to rate inflation which is seen when small crime counts in a small area result in a meaningfully high LQ. Second, the street network buffer method, while an improvement, still involves Euclidean buffers which are able to capture street segments that are not physically connected to the location (e.g., dead-end streets that fall within the 60ft buffer but are not connected to the greenspace).

Chapter 2 also focuses solely on the concentration of crime around greenspaces and does not consider the impact of any other factors on this relationship, including amenities, land use, or neighborhood characteristics. While chapter 3 does include an examination of amenities and land use, it is still limited by the absence of neighborhood characteristics in analyses. Further, chapter 3 does not examine the specific land use types surrounding small parks which could yield different findings. Finally, there is no consideration of the temporal

variation of crime around greenspaces and parks. Some crimes may be more likely to occur at specific times of the day, specific days of the week, or during different times of the year. All of these factors are important to consider in future research looking at the relationship between greenspaces and crime.

Implications – Portland Greenspaces

The results of this research have important implications for Portland greenspaces and small parks in particular. The findings suggest that overall, greenspaces do not appear to have a concentration of crime, however, different greenspaces may experience a concentration of specific crime types (e.g., public gardens and theft from motor vehicles). This information could be used by the city to implement specific crime prevention strategies where appropriate. Further, these results suggest that small parks experience consistent high levels of concentration across crime types and, as such, should be the target of strong crime prevention efforts. Particularly, the top 10 small parks account for 66.6% of all crime occurring around small parks. These locations should be targeted for crime prevention strategies and improvements, which could involve situational crime prevention or crime prevention through environmental design (CPTED) techniques.

Implications – Future Research

The two papers in this thesis presented an improved method for measuring crime concentration as a location quotient around specific location types. By excluding all area where the Portland Police Bureau do not record crimes, and only including areas where they do (along the street network), the methods reduced the impact of rate inflation often

seen with location quotients. Further, this method offers an improved way for researchers or practitioners to work with crime data that is offset from, or not connected to the street network. The increased availability of crime data that is aggregated in some way (as is the case in this research) makes it important to have a meaningful way to measure crime concentration around not only greenspaces, but any specific locations.

While these papers contribute to the current literature on greenspaces and crime, more work needs to be done to fully understand this relationship. First, temporal analyses of the relationship between greenspaces and crime is an important avenue for future research. This involves examining the relationship at different hours of the day, through to annual patterns and changes. Second, obtaining data on greenspace usage (i.e., how many people travel to the location) would be important for further examining the role of greenspaces as crime generators or attractors—which theoretically rely on the usage of places by people. Finally, examining the effect of neighborhood characteristics on the greenspace-crime relationship is imperative. This includes social disorganization, population density, and other demographic characteristics that could influence this relationship.

Conclusion

This thesis presents two original research papers that examine the relationship between greenspaces and crime in Portland, Oregon. The methodological adaption presented in these two papers offers an improved way for future researchers to measure crime concentration around specific locations using publicly available—and aggregated—crime data. The findings of these two papers suggest that, on the whole, greenspaces in

Portland do not experience a concentration of crime, however, certain greenspaces appear to experience a concentration of certain crime types. In particular, small parks experience a concentration of most crime types included in this study, although a few high crime parks account for the majority of crimes. Further, the presence of certain amenities at small parks seem to be associated with higher or lower levels of different crime types. Finally, the land use types surrounding small parks appear to also be related to the level of crime at these locations. This suggests that a focus on small parks in Portland could be beneficial for reducing crime and protecting parks as an important element of urban life.

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