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The Impacts of Green Spaces on Crime in New York City

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The Impacts of Green Spaces on Crime in New York City
Matthew Iannone
Environmental Studies and Urban Studies Senior Thesis

Chapter 1:
Urban Crime and Green Space: How New York City Parks Could Reduce Crime Rates

Abstract

High crime rates have always been a characteristic of urban areas. Some of the largest and most worldly cities are also among the most dangerous. High densities of people tend to result in an increase of crimes committed, especially when other stresses are added to the situation. Changes in weather, financial standing, and the surrounding physical environment are only three factors that correlate with crime rates. Studies have also shown, however, that natural green spaces in urban landscapes can reduce stress. The presence of trees in urban areas has many environmental benefits, like controlling ground runoff and contributing to ambient air temperature reduction. Trees can also improve the mental wellbeing of individuals. While interning with the Crime Strategies Unit, an intelligence division within the New York County District Attorney's Office, crime data was gathered and analyzed in order to derive a correlation between crime occurrences and natural green spaces in Northern Manhattan. This study drew on knowledge from the fields of criminal psychology, environmental psychology, and urban planning. Crime data for the past year (2015) was taken from CompStat 2.0 and the United States Census Bureau, primarily. Crimes were evaluated as two categories: personal crimes, specifically assault, homicide, and rape, and property crimes, specifically robbery, burglary, and grand larceny auto. By evaluating what types of crimes happen in cities, and where they tend to happen the most, city planners can be informed on how to construct the urban environment to promote safety, environmental health, and mental health among citizens, all while reducing crime rates.

Keywords: green space, urban crime, criminal psychology, environmental psychology

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Introduction: The NYCDA and City Parks

According to the 2009 Statistical Abstract of the United States, metropolitan statistical areas (MSAs) have 13.58% more violent crimes than other American cities just outside metropolitan areas, and 126.6% more violent crimes than rural areas. (U.S. Census) Metropolitan statistical areas are defined as a geographic urban area of 50,000 or more population, and surrounding micro areas containing an urban core of at least 10,000, but less than 50,000, population. Metro and micro areas that compose the metropolitan statistical area have a high degree of social and economic integration, which is measured by commuting to work, with the urban core. (U.S. Census) The Federal Bureau of Investigation (FBI) recognizes murder, rape, and robbery as violent crimes within the United States, and along with the United States Census Bureau, documents crime statistics from localized jurisdictions around the country.

New York City is among the most largest and prestigious cities in the world in terms of diversity, population, culture, and economy. With a resident population of 8.406 million citizens in New York City alone, the New York metropolitan statistical area, defined as New York as far north as Ulster county, much of Connecticut and New Jersey, as well as a slice of eastern Pennsylvania, includes a total population of 20.2 million people, many of whom either commute into the city daily for work, if not at least regularly for other purposes. (U.S. Census) Additionally, New York City saw nearly 60 million tourists from around the world in 2015. (McGeehan) With such a large mass of people actively inhabiting and interacting on Manhattan's mere 22.8 square miles, law enforcement must be effective in preventing crimes, prosecutors must be swift and just in keeping criminals off the streets, and prisons must be capable of securing thousands of criminals in order to keep New York City safe.

Over the course of the 2016 fall semester, I had the privilege of interning for the Crime Strategies Unit (CSU), a division within the New York County District Attorney's office.

District Attorney Cyrus Vance created the Crime Strategies Unit as part of an initiative in New York to fight crime in innovative and creative ways. The District Attorney's website describes the Crime Strategies Unit's mission as:

“To harness the collective resources of the District Attorney's Office in order to develop and implement intelligence-driven prosecution strategies that address crime issues and target priority offenders.” (Manhattan DA)

Working in full partnership with the New York Police Department (NYPD), other law enforcement agencies, and local community groups, the CSU and the District Attorney's Office seek to identify high-risk individuals that have either committed a crime before or that may be likely to commit one in the future. The Crime Strategies Units highlights individuals, gangs, and geographic areas within the city, like specific buildings, streets, entire blocks, and neighborhoods, when crimes occur, in order to devise an efficient and strategic surveillance plan for the NYPD to employ. The precincts of Manhattan have been grouped into five geographic areas, with a senior prosecutor from the Crime Strategies Unit assigned to focus on and understand the criminal activity in each of the areas. (Manhattan DA)

As an intern, I served as an intelligence analyst and as an aide to Assistant District Attorney Molly Brottmiller with the Crime Strategies Unit. Some of my daily responsibilities included listening to and transcribing phone calls from high-risk prisoners at Rikers Island, assembling case files to be presented during trials, attend trials, and evaluate cases to determine connections and crime trends. When listening to phone calls from prisoners I listen for code and slang words, names, and incriminating evidence related to either the crime the inmate is in prison for, or related to crimes that may be committed outside of prison in Manhattan.

The crime trends I examined were typically specific to individuals or small groups of people and were usually concerned with the types of crimes, who were committing the crime, as well as location in the city. Coming off of a summer job researching rooftop gardens in New York City, I was curious whether or not there was a correlation between crime and proximity to green spaces. Edward Glaeser theorizes that 45-60% of the reason that crime rates are so high in urban areas is because of how behavior is influenced by observable characteristics of individuals and cities, namely those that reflect tastes, social influences, and family structure. (Glaeser) Studies have also shown that exposure to nature can increase mental health and reduce stress. (University of Minnesota) By utilizing the resources provided to me through the Crime Strategies Unit, I was able to analyze modern urban crime rates and statistics, as well as environmental and urban planning statistics, from New York City.

While this research was minimal in its extensiveness, as the time allotted for the internship was short at only one day per week, as well as the fact that a study of this magnitude requires analysis of data spanning multiple years, I believe the findings support existing theories that increased natural spaces in urban areas help to reduce crime via an affect on the mental wellbeing of citizens. Of course, dozens of other factors have contributed to reductions in crime rates around the world and in New York, like improved surveillance technology and policing strategies, to name a few, but the following study is concerned with the prevalence of crime locations, as opposed to the prevalence of crime type or their occurrences.

While only a sliver of a much more extensive and significant phenomenon spanning numerous fields of study and millions of case-specific towns, I hope to expand my research in order to provide a comprehensive criminal-environmental evaluation of New York City. I firmly believe that an increase in green spaces, natural elements, both in terms of processed

construction materials and organic elements, as well as in citizen participation with the environment can benefit human and environmental health, urban planning, in terms of efficiency and natural aesthetic, and even economic development.

New York City Crime and Environmental Statistics

Urban areas see the highest crime rates of any of the three traditionally observed geographic communities: urban (sometimes referred to as “metro”), suburban (sometimes referred to as “outside-metro”), and rural (sometimes referred to as “non-metro”). New York City is among these urban areas. This study only focused on a “Manhattan North,” essentially the northern half of Manhattan, defined by the NYPD as any land north of 59th Street and that falls within the natural borders of Manhattan Island, that is, the rivers. (Compstat 2.0) Note that any islands, like Rikers Island, Randall’s-Ward Island, and Roosevelt Island to name a few, are not included in the Manhattan North data.

Violent crimes, as recognized by the U.S. Department of Justice, include murder, forcible rape, robbery, and aggravated assault. Property crimes include burglary, larceny-theft, and motor vehicle theft. (U.S. Census) National crime rates by geographic community from 2009 clearly show an overall increase in violent crimes as the distance from metro areas decreases, except for rape and aggravated assault occurrences. (Appendix I) Violent crimes in metro areas are 15.7% higher than those in outside-metro areas, and 126.6% higher than those in non-metro areas. To further break down violent crimes, the national murder rate in metro-areas is 23.07% higher than in outside-metro areas, and 34.62% higher than in non-metro areas. Robbery rates are 58.5% higher in outside-metro areas and 88.89% in non-metro areas. (Table I)

The occurrence rates for forcible rape and aggravated assaults go against this trend for outside-metro areas, however, with forcible rape rates being 31.55% higher in outside-metro areas than metro areas. Aggravated assault rates in outside-metro areas are only 5.2% higher than in metro areas. Rural areas do follow the trend of increased violent crime rates closer to cities, however, with a forcible rape rate 12.77% higher than in metro areas and an aggravated assault

rate 42.31% higher than in metro areas. (Table I) Herzog and Kutzli theorize that rapes and assaults tend to be more intimate and to last a longer duration than a murder or robbery, and less densely populated areas, like the outside-metro cities, which tend to have populations greater than 10,000 but less than 50,000, better foster private, surveillance-less locations. Rape and aggravated assault rates are lower in non-metro cities/towns/villages, however, because of significantly lower populations (less than 10,000) than metro and outside-metro areas. (Herzog and Kutzli)

Property crime rates go against the aforementioned geographic crime trend for outside-metro areas with burglary and larceny rates 11.58% and 20.28% higher than in metro areas, respectively, and an overall property crime rate at 13.62% higher. (Table II) Herzog and Kutzli's theory again explains this opposition to the trend, as burglary and larceny success rates are heavily dependent on lessened technological and human surveillance. (Herzog and Kutzli) The overall property crime rate in non-metro areas is in agreement with the trend being 49.67% higher in metro areas. The burglary and larceny rates are 23.99% and 57.53% higher in metro areas, respectively. (Table II)

The motor vehicle theft rate in metro areas was 50.14% and 63.18% higher, respectively, than in outside-metro and non-metro cities/towns/villages, however. (Table II) This may be explained by the fact that there are significantly more vehicles in metro areas. For instance, as of 2015 New York County recognized over 2.1 million registered vehicles, a significantly higher amount than in any other New York, with Suffolk County in ranked second with approximately 1.2 million registered vehicles. (NY DMV) Millions of cars densely concentrated, frequent vehicle "standing," and slow, stop-and-go traffic may also contribute to higher motor vehicle theft rates as well.

Although the 2009 crime rate by geographic community data may be slightly outdated, it is the most detailed crime-specific data released by the FBI, so far. Additionally, it is still representative of 2011 overall violent and property crime rates. Violent crime rates have decreased since 2009, from 458.7 persons per 100,000 to 319.5 persons per 100,000, and the crime rate increases as distance from metro areas decreases, in accordance with the 2009 data. (Appendix I and II) Similarly, property crime rates have also decreased since 2009, from 3036.1 persons per 100,000 to 2,746.67 persons per 100,000. Note that property crime rates are still higher in outside-metro areas than in metro and non-metro areas, and metro crime rates are still higher than in non-metro areas. (Appendices I and III)

Crime data in this study was collected from the New York Police Department's Compstat 2.0 database between the dates of January 1, 2015 and November 27, 2015, thus are not representative of the full 365-day year. From here on out, when data is referred to being from 2015 it is meant from between the aforementioned dates. Additionally, the discussed data in this study is only from the violent crime category, specifically murder, rape, and felony (aggravated) assault. Further, the discussed data is only taken from the previously mentioned and defined Manhattan North patrol borough.

To address the calculated data used in assessing violent crime proximity to New York City public parks, the NYPD CompStat 2.0 crime map of Manhattan North was used. Blocks between crime occurrences, which are estimated by the NYPD to the nearest intersection except for those that occurred within a public park, which are reported as such, were manually counted and recorded. In order to account for variation in block size, an average of 13.5 blocks per mile was used. (Pollak) This ratio is used to refer to the crime locations, with "one block" equivalent to .074 miles, "two blocks" equivalent to .148 miles, and so on. "Zero blocks" signifies crimes

that occurred both within and on the border of a public park. The parks used as reference points are all at least one block by one block, or .074 by .074 miles, and have, in some capacity, combinations of tall and short vegetation, pathways, fences that distinguish the area from the street, and terraces equipped with tables, chairs, benches, and/or installed water displays. Other characteristics that weren't necessarily taken into account are architecture and style of bridges, structures, and art installations, as well as things like percent natural and artificial ground, height of vegetation, or type of vegetation. A longer-term study could possibly take these qualities into account. Lastly, note that data for violent crime proximity to bodies of water in Manhattan North, namely the Hudson, East, and Harlem Rivers was also calculated, although not used in this study but perhaps in future research. This data was collected and calculated in a similar manner to the public park data. Unfortunately, manually calculating proximity data for the 1,998 felony assaults was unfeasible within the allotted time period, although more extensive research in the future would aim to include it, as well as property crimes, which also tally well into the multiple thousands.

There were 25 murders in Northern Manhattan in 2015, although only 23 were reported on the CompStat 2.0 crime map. It is unknown by this study why certain murders were not included on the map, although it may be because they are ongoing cases that cannot be included yet. Of the 23 mapped murders, none occurred within or on the border of a New York City public park, that is, zero blocks away. Five murders occurred within one block of a public park. Seven murders occurred within two blocks of public parks. Eight murders occurred within three blocks of public parks, the most murders in the by-block analysis. Two murders occurred within four blocks of a public park, and only one murder occurred within five blocks. No murders occurred within more than five blocks of a public park, although this is partially because it's

almost impossible to ever be further than five, or .37 miles, from one in Manhattan North. (Table III)

There were 164 instances of forcible rape in Northern Manhattan in 2015, although only 133 are included on the CompStat 2.0 crime map. As mentioned above, some rape cases may not be included because of ongoing cases, but this is only speculation. Of the 133 included rape instances, thirteen occurred within or on the border of a public park, that is, zero blocks away. Thirty-two rapes occurred within one block of a public park, the most forcible rape instances in the by-block analysis. Twenty-eight rapes occurred within two blocks of a public park, while twenty-nine rapes occurred within three blocks. Sixteen, nine, and six rapes occurred within four, five, and six blocks of a public park, respectively. No instances of forcible rape occurred within further than six blocks, although this is partially because of the same reason mentioned prior in reference to murders; there are very few places in Manhattan North where a person can be more than five blocks away from a public park. (Table III)

Environmental Psychology in Urban Landscapes

Kuo and Sullivan theorize that in poor inner-city neighborhoods, vegetation can inhibit crime through two mechanisms: by increasing surveillance and by mitigating some of the psychological precursors to violence. (Kuo and Sullivan) Studies have shown that perpetrators avoid areas with greater surveillance and greater likelihood of intervention. Research has also shown that criminals avoid well-used residential areas where their activities might easily be observed. Jane Jacobs suggested that the mere presence of “eyes on the street” would be enough to deter crime. She proposes achieving this by encouraging people to interact in the street with each other, with stores, and with public places. A 1997 study conducted by Kuo and Sullivan suggested that vegetation might have the capacity to increase eyes of the street. (Kuo and Sullivan, *Environment and Behavior*)

Further studies conducted by Kuo and Sullivan revealed a positive correlation between treed outdoor spaces and the number of youth, adults, and mixed-age groups that use the spaces. More people utilize heavily treed outdoor spaces than treeless spaces. Additionally, the more trees that are in a space, the greater the number of simultaneous users. (Kuo and Sullivan, *Environment and Behavior*) With more people outside using public spaces, seeing other people, and also being seen by other people, communities can achieve the “eyes on the streets” benefits that Jane Jacobs theorized about. Studies have also shown that criminals are more likely to be deterred when there are environmental cues that give the illusion of surveillance, even when no observers are present. (Newman) Similarly, territorial markers, namely vegetative maintenance, can deter criminals in residential neighborhoods as they associate the upkeep with recent homeowner activity. (Chaudhury)

Kuo and Sullivan also theorize that an additional mechanism by which vegetation might inhibit crime is through mitigating mental fatigue. Mental fatigue is a psychobiological state caused by prolonged periods of demanding cognitive activity. (Marcora) Studies have suggested that symptoms of mental fatigue may be an increased physiological predisposition to outbursts of anger and potentially violence. Other symptoms of mental fatigue include irritability, inattentiveness, and decreased control over impulses, all of which are psychological precursors to violence. Kuo and Sullivan cite multiple sources that show links between irritability and aggression, inattentiveness with aggression, and impulsivity with both aggression and violence. (Kuo and Sullivan, *Environment and Behavior*)

Numerous studies have been conducted over the last forty years, more or less, that indicate that vegetation aids in the recovery from mental fatigue. Even more extensively discussed are the physical and mental benefits that come from exposure to the natural world. Physical benefits include a raise in Vitamin D levels, which helps protect children from future bone problems, heart disease, diabetes, and numerous other health issues. (American Academy of Pediatrics) Time spent outdoors also lowers the chance of nearsightedness while also improving distance vision. (Holden) Outdoor activity and play also has the obvious physical benefits of muscle growth, weight loss, increased lung capacity, and an increase in overall fitness levels. (CDC)

Mental benefits of exposure to natural settings may contribute to a decrease in urban crime rates, which will be further discussed in the following paragraph. Interacting with nature has been shown to be widely effective in reducing ADHD symptoms. (Wells) Urban governments have recently begun to encourage school systems to incorporate environmental education programs into their curriculums following studies showing significantly higher scores

on standardized tests in math, reading, writing, and listening from students participating in the environmental programs. (Bartosh)

Richard Louv famously argues that today's generation of children prefer to stay inside and that they are suffering from a disconnect with nature and the outside world in his book "Last Child in the Woods." Louv cites studies that reinforce theories that extensive time spent indoors is detrimental to physical and mental health, as well as that it takes away from one's ability to socialize. Those suffering a disconnect with nature either never learned to socialize, or their social skills degrade over time. Many people that didn't have much exposure to nature as children are often shy, fearful of strangers, fearful of nature, preoccupied with technology, and have poor time management skills. Losing these social skills can further lead to the development of mental fatigue, which of course is composed of irritability, inattentiveness, and impulsivity, as was previously mentioned. (Louv)

Just as exposure to nature has numerous benefits on mental health and intelligence, it similarly aids in recovery from mental fatigue. Kuo and Sullivan report that contact with nature in a variety of forms, whether it be in wilderness areas, prairies, community parks, window views, and even interior plants is systematically linked with enhanced cognitive functioning. Enhanced cognitive function includes reductions in irritability, inattentiveness, and impulsivity, three of the major symptoms of mental fatigue. These same symptoms, as was previously discussed, have been shown to lead to aggression and violence, so a reduction in them would logically result in a decrease in violent behavior. (Kuo and Sullivan)

Ultimately, Kuo and Sullivan argue that vegetation can deter crime in neighborhoods by increasing informal surveillance of neighborhood spaces, by increasing the implied surveillance of these spaces, and by mitigating mental fatigue, thus reducing the potential for violence. Lastly,

all points of evidence mentioned in this chapter, as well as thousands of other studies not included, support the theory that increased exposure to natural spaces leads to improved mental health and cognitive functioning, thus follows the deduction that exposure leads to a reduction in crime rates.

Criminal Psychology in Urban Landscapes

Causes of crime, as well as the reasons why people commit crimes, are complex to explain and determine crime trends and typologies. Most people today accept that poverty, low self-esteem, parental neglect, and alcohol and drug abuse are all connected in explaining why people commit crimes. Classifying criminals isn't this easy, however, especially when approaching the topic from fields of criminal psychology or physiological health. Some people are at a greater risk of becoming criminals because of the circumstances into which they are born. (*Causes and Types of Crime*) For instance, some people are genetically inclined to develop serious mental illnesses that may jeopardize mental stability and functioning. This study, however, is concerned with environmental psychology, criminal psychology, and the intersection of the two fields in terms of crime occurrence proximity to New York City public parks.

While cities tend to attract on average individuals with more human capital, that is, they tend to be intelligent and wealthy, cities also attract individuals drawn disproportionately from the bottom of the human capital distribution. In simpler terms, cities attract some of the wealthiest and some of the poorest individuals. (Glaeser and Sacerdote) This could create a relatively tense climate with the poor fighting to survive in a world owned by the wealthy. Stress to earn money, potential drug and alcohol use, and will to survive may lead to mental fatigue and a need to commit a crime. Additionally, urban conditions such as crowding, high temperatures, and high levels of noise have all been linked to aggression and violence. (Baker) The physical and mental benefits of nature in people's lives have already been explained, but detailed evidence that exposure to nature reduces crime in urban areas has yet to be properly presented.

Among minor crimes, there is less graffiti, vandalism, and littering in outdoor spaces with natural landscapes than in comparable plant-less spaces. (Brunson) Public housing residents with

nearby trees and natural landscapes reported 25% fewer acts of domestic aggression and violence. (Kuo and Sullivan) Additionally, public housing buildings with greater amounts of vegetation had 52% fewer total crimes, 48% fewer property crimes, and 56% fewer violent crimes than buildings with low amounts of vegetation. (Kuo and Sullivan) Studies of residential neighborhoods found that property crimes were less frequent when there were trees in the right-of-way, and more abundant vegetation around a house. (Donovan and Prestmon) In parts of cities that received location-specific treatments, like cleaned up vacant lots, construction of public parks, and repairs of buildings and amenities, there was a 20% overall decrease in calls to police. (Braga and Bond) Vegetation can be managed to create a reassuring environment, reduce fear, and increase citizen surveillance and defensible space to ultimately reduce the occurrence of crimes.

Environmental Urban Planning in New York City to Reduce Crime

It's often the case in urban areas, especially in New York City, for property managers, realtors, landowners, and architects to remove vegetation in the name of safety and management concerns. Vegetation, however, can be retained and managed to reduce risk. Studies have shown that open green spaces that preserve visibility, as opposed to closed green space that limits views, increase feelings of personal safety as a person is better able to detect potential nearby safety risks. (Mass) Greater openness is associated with less perceived danger. (Hanyu) Exclusively open green space is not necessarily the right design technique, though.

A site can support both trees and visibility, that is, open space. Inner-city residents at a public housing complex in Chicago claimed that higher tree density and grass maintenance increased both setting preference and sense of safety. (Kuo and Sullivan) Further studies have shown that crime rates were lower in widely spaced green spaces with high-canopy trees and grassy areas, as opposed to paved areas. This combination of vegetation is optimal for urban green spaces because neither type would block views. Vegetation is likely to increase crime only when it affords opportunities for concealment, particularly in undergrowth, thus stressing the importance of vegetation maintenance. (Kuo and Sullivan)

Manicured, maintained vegetation is important in order to achieve a higher level of perceived security. (Kuo) Maintenance neglect, such as not cleaning up litter or graffiti, decreases perceived security in urban parks because it represents a lack of care and surveillance. (Nasar and Fisher) Powerful social messages are conveyed by a well-tended setting, which indicates that it has been cared for and under the oversight of a caring agent. Such settings encourage a sense of orderliness and security. Research has suggested that there is a correlation

between lack of setting care and fear of crime, although the relationship between lack of care and actual victimization is a weaker correlation. (Nasar and Fisher)

When designing urban areas, specifically appealing parks and greenways, the optimal design to reduce crime and increase safety, as well as to realize the numerous benefits of natural spaces, as have been discussed, is to meet the qualities detailed above. The presence of nature, including higher densities of trees, is preferred. An open understory that provides adequate visibility increases perceived safety in urban park settings. (Gobster and Westphal) This is not to say that landscape designs should not include understory, low growing vegetation, but rather suggests that managers should be sensitive to where they place and how they manage vegetation considering personal safety concerns. (Kuo and Sullivan)

The collected data encourages an increase in green spaces in urban areas. More murders occurred at two and three blocks from public parks than did within one block. The further from a public park one travels, the higher the prevalence of murders. A similar trend follows instances of rape. More instances of rape occurred within two and three blocks from public parks than within one block. For both murder and rape occurrences in Manhattan North, the prevalence of crime instances decreased when four blocks or further from public parks. According to the data, green spaces every two to four blocks would be the most optimal arrangement in Manhattan North to decrease crime.

Although there has recently been in a big push in society to invest in green architecture and technology, as well as an increased appreciation for parks, greenways, and green spaces, building public parks every two to four blocks in Manhattan, where land is tremendously valuable, is unfeasible. Developers wouldn't support so many parks, and the demand for so many parks is most likely not that high to warrant to many parks. Instead of trying to build parks or

green spaces, it is more effective and feasible to find creative ways to include natural elements in the city. City programs to plant trees on Manhattan streets have been effective in equally incorporating nature uniformly throughout the city.

Conclusion

Although crime rates have consistently declined over time in urban areas, the crime still poses a problem in New York City. Increased police efforts have helped to crack down on the occurrence of crime in Manhattan, but further action can still be taken. Data collected in Manhattan North for murder and rape instances was in agreement with the original Kuo and Sullivan theory that an increase in natural green spaces in urban areas leads to a decrease in crime. Although the data supports the claim, a more extensive study would need to be conducted over multiple years, multiple types of crimes, and for all of Manhattan. Additionally, without more data establishing a strong base to evaluate the Kuo-Sullivan theory, no concrete conclusion can be fairly made. Many different factors may have affects on crime rates besides an absence of exposure to nature, like time of year, economy, and poverty, to name a few possible factors. At the very least, the physical benefits of exposure to nature are tremendous and enough to warrant an increase of natural elements incorporated into urban areas. On the surface, increased environmental aspects included in the city also benefits mental health and has the capacity to reduce crime rates.

Appendices

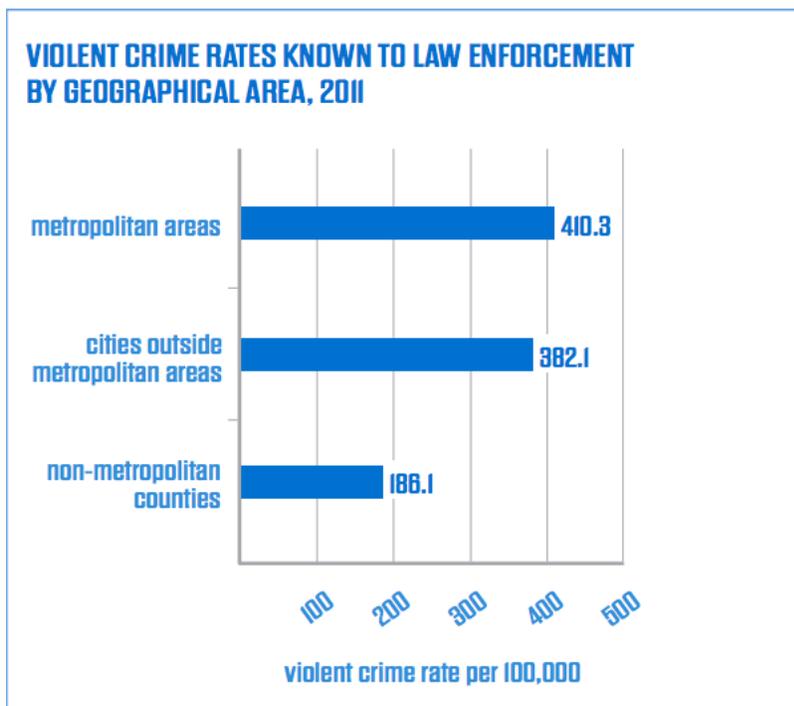
Appendix I: Crimes and Crime Rates by Type and Geographic Community: 2009

Table 307. Crimes and Crime Rates by Type and Geographic Community: 2009
 [Rate per 100,000 population. For year ending March 31. Data include offenses actually reported to law enforcement and also offense estimations for nonreporting and partially reporting agencies within each state. Rates are based on Census Bureau estimated resident population as of July 1]

Type of Crime	United States		Metropolitan Statistical Area \1		Cities outside metropolitan areas		Nonmetropolitan counties	
	Total	Rate	Total	Rate	Total	Rate	Total	Rate
Violent crime	1,318,398	429.4	1,177,758	458.7	79,446	396.4	61,194	202.4
Murder \2	15,241	5.0	13,408	5.2	798	4.0	1,035	3.4
Forcible rape	88,097	28.7	72,413	28.2	8,259	41.2	7,425	24.6
Robbery	408,217	133.0	390,483	152.1	12,639	63.1	5,095	16.9
Aggravated assault	806,843	262.8	701,454	273.2	57,750	288.2	47,639	157.6
Property crime	9,320,971	3,036.1	8,113,233	3,160.2	733,161	3,658.5	474,577	1,569.8
Burglary	2,199,125	716.3	1,867,157	727.3	164,859	822.6	167,109	552.8
Larceny-theft	6,327,230	2,060.9	5,511,868	2,146.9	539,720	2,693.2	275,642	911.7
Motor vehicle theft	794,616	258.8	734,208	286.0	28,582	142.6	31,826	105.3

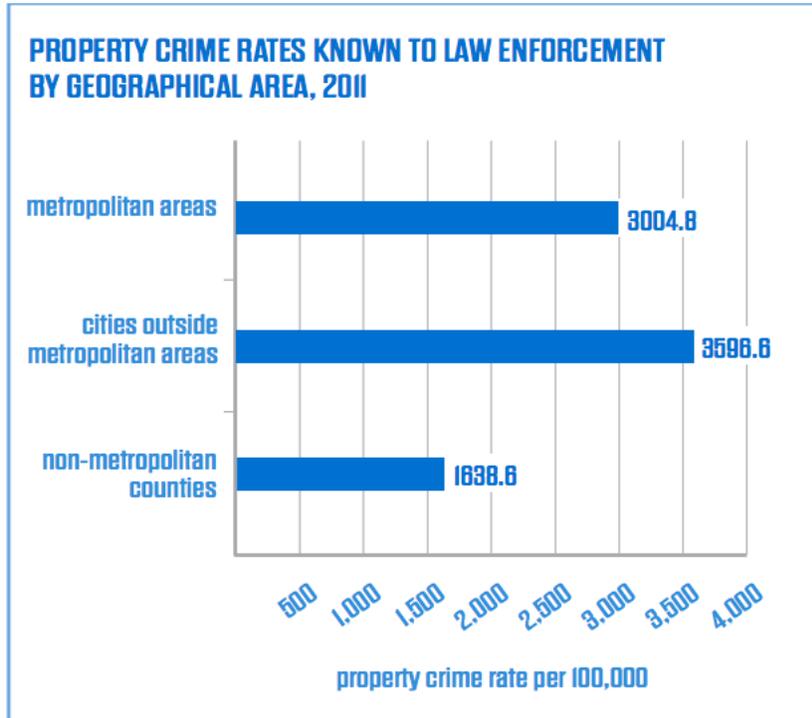
Appendix I. Source: U.S. Department of Justice, Federal Bureau of Investigation; Crime in the United States, 2010. United States Census Bureau. <http://www.census.gov/library/publications/2011/compendia/statab/131ed/law-enforcement-courts-prisons.html>

Appendix II: U.S. Violent Crime Rates Known to Law Enforcement by Geographical Area, 2011



The National Center for Victims of Crime, National Census of Victim Service Providers. "Urban and Rural Crime Statistics, 2014." <http://victimsofcrime.org/docs/default-source/ncvrvw2014/urban-rural-crime-statistics-2014.pdf?sfvrsn=2>

Appendix III: U.S. Property Crime Rates Known to Law Enforcement by Geographical Area, 2011



The National Center for Victims of Crime, National Census of Victim Service Providers. "Urban and Rural Crime Statistics, 2014." <http://victimsofcrime.org/docs/default-source/ncvrv2014/urban-rural-crime-statistics-2014.pdf?sfvrsn=2>

Tables

Table I: U.S. Violent Crime Rate Percentages by Geographic Community, 2009

	Metro Areas to Outside-Metro Areas	Metro Areas to Non-Metro Areas
Violent Crime	15.7%	126.6%
Murder	23.07%	34.62%
Rape	-31.55%	12.77%
Robbery	58.5%	88.89%
Aggravated Assault	-5.2%	42.31%

Table I was self-generated. The values are manipulations of data from Appendix I. The values were calculated using the ratio of violent crime, murder, forcible rape, robbery, and aggravated assault rates in metro areas to those of outside-metro and non-metro areas, respectively.

Table II: U.S. Property Crime Rate Percentages by Geographic Community, 2009

	Metro Areas to Outside-Metro Areas	Metro Areas to Non-Metro Areas
Property Crime	-13.62%	49.67%
Burglary	-11.58%	23.99%
Larceny-Theft	-20.28%	57.53%
Motor Vehicle Theft	50.14%	63.18%

Table II was self-generated. The values are manipulations of data from Appendix I. The values were calculated using the ratio of property crime, burglary, larceny-theft, and motor vehicle theft rates in metro area to those of outside-metro area and non-metro areas, respectively.

Table III: Proximity of Murder and Rape Occurrences to New York City Public Parks in Manhattan North, 01/01/2015-11/27/2015

Blocks	Miles	Murder Occurrences	Rape Occurrences
0	0	0	13
1	.074	5	32
2	.148	7	28
3	.222	8	29
4	.296	2	16
5	.37	1	9
6	.444	0	6
Total		23	133

Table III was self-generated. The values are calculations derived from the New York Police Department's "CompStat 2.0" 2015 Manhattan North crime statistics and crime map. An average 13.5 blocks per mile was used to account for block size variation. The methods used to collect and calculate the data are further explained in Chapter 1.

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**Chapter 2:
The Effects of Community Gardens on Crime in the Bronx**

Abstract

From the early 1960s through the mid-1990s, crime in New York City ran rampant. With a gradually dwindling police during this time, a high unemployment rate, and an rapidly increasing metropolitan population, crime peaked in the early 1990s, with the murder rate hitting a record-high of 2,245 in 1990. When Mayor Rudy Giuliani took office in 1994 and appoint Bill Bratton as the NYPD police commissioner, these rates immediately plunged. Numerous factors may have contributed to this sudden decline in crime: the police force grew significantly through the 1990s, more criminals were placed and held in prison, and the economic boom of the 1990s brought with it a tremendous drop in the national and city unemployment rate. While economic factors have traditionally been regarded as the leading factor in impacting the occurrence of crime, recent research into the effects of green spaces on crime rates have opened the door to alternate explanations. Some studies indicate that greening areas helps to deter crime by “signaling to potential criminals that a house is better cared for and, therefore, subject to more effective authority.” Other studies have gone as far as to draw a link between mental fatigue and an increase in crime, claiming that green spaces serve as a calming and crime-detering agent. While the field of environmental criminology is relatively young in its depth of research, this study aims to further only a small component of the discipline: the effects of green spaces on social disorder and social cohesion. Based off of the findings from previous research conducted by Matthew Iannone regarding the presence of green spaces in Manhattan, this study looked at the occurrence of 8,149 violent crimes (assault, murder, rape, and robbery) in the Bronx from January 1, 2016 to December 31, 2017.

Keywords: Social Cohesion, Social Disorder, Social Organization, Crime Opportunity, Perception of Safety, Fear

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Introduction

Historically, crime in New York City has been higher than most anywhere else in the United States. Through the 1970s and 1980s the crime rate soared in New York City, and as the city government and residents fell into economic despair so did the quality of life. Attempts to fight crime proved troublesome and expensive. It wasn't until the mid-1990s when Police Commissioner Bratton came into power that the city saw a reduction in crime. By employing tactics derived from Wilson and Kelling's "Broken Windows Theory," Bratton succeeded in turning the city around. This decline in the crime rate in New York City has held steady since the 1990s. However, this is not to say that crime has disappeared entirely or that it is no longer a problem. Flooding the streets with police officers has proved expensive and has caused social tension with accusations of profiling and overuse of "Stop and Frisk." Further, this strategy fails to address the root of the problem and instead fills prisons beyond capacity. Now, as New York City reemerges as a global city, it's as good a time as any to reevaluate crime fighting strategies.

Social cohesion, that is, "the willingness of members of a society to cooperate with each other in order to survive and prosper," may be at the source of crime. Creating an environment in which residents within neighborhood communities freely choose to form partnerships and have a reasonable chance of realizing goals by working alongside others could repair communities both physically and socially, thus reducing crime and social disorder. (Stanley) Social disorder, while encompassing a wide range, tends to include crime, social control, social disorganization, physical neighborhood decay, foreclosure, and heightened fear of crime. The concept requires an understanding of many different facets of city government and planning, but essentially leads to the occurrence of crime. (Wallace and Scott) As the poverty rate increases, neighbors lose trust in each other, and physical appearances decline, crime is socially permitted. When considering

this topic, we must ask ourselves what we can do to improve social cohesion, reduce social disorder, and ultimately create a safe and trusting community.

Looking at this from an environmental standpoint, community gardens may have the capacity to create social cohesion. Community gardens offer a safe, neighborly space where residents can interact, form bonds, and work together towards a common goal. By introducing community gardens into areas with high crime rates, residents may be able to “self-police,” in a way, by becoming more involved in their communities. Existing studies have tended to neglect the social cohesion aspect of neighborhoods and instead tend to focus on the economic factors, especially in regards to land use. This study aimed to look at the intersection, however, of community garden benefits and social cohesion factors in order to identify the social benefits and crime fighting capabilities of the gardens.

Literature Review

There is evidence that suggests that urban decay leads to social disorder. Urban decay, which includes, but is not limited to, graffiti, vandalism, broken windows, and vacant lots, prompts people to believe that the property is uncared for, nobody cares, and there is no authority over the property. (Gladwell, 2000) Potential criminals see these places as isolated locations where criminal activity can be conducted without repercussion. Wilson and Kelling (1982) urge that social disorder and crime are inseparably linked. They proposed the broken windows theory, which says that even the smallest sign of decay of a property, like a broken window, will lead to increasing decay if left unrepaired: “one unrepaired broken window is a signal that no one cares, and so breaking more windows costs nothing.” (Wilson and Kelling, 1982)

They go on to describe a 1969 experiment conducted by Stanford psychologist Philip Zimbardo in which a car was left abandoned on a Bronx street. Within minutes the car was scrapped for salvageable parts, followed by “random destruction:” smashed windows, torn upholstery, and the vehicle’s dismantlement. A second car left on a Palo Alto street remained untouched for a week. When Zimbardo returned and smashed one of the windows, others soon joined in, flipping the car and completely destroying it. Wilson and Kelling conclude that “unattended property becomes fair game for people out for fun or plunder.” (1982) This example demonstrated that something which is neglected can quickly become an object of vandalism.

Applying Zimbardo’s findings to the community scale, Wilson and Kelling theorized that increased police presence and police enforcement for crimes as small as a broken window or graffiti would lead to a reduction in these crimes. Kelling writes that by addressing the small problems in a neighborhood the community becomes empowered. (Wilson and Kelling, 1982) Private properties receive the care and pride they deserve, and public properties are claimed by

the community, all of which extends to concern for what happens in the streets. Order is restored and maintained, and society becomes strengthened as a whole.

Unenforced behavior operates in anonymity, uninterrupted by the surrounding community. When crime occurs so frequently, the local population either contributes to the decay or is too scared to intervene. Keizer and Lindenberg (2008) found that when people observe others violating a particular social norm or law, they are more likely to violate other norms or laws, leading to the spread of social disorder. Similarly, crime opportunity theory argues that crimes tend to occur when appropriate opportunities present themselves to an individual. (Wilcox and Cullen, 2017) Decreased “eyes on the street,” care for one's neighborhood and property, and physical disorder all create the perfect environment, and present the ideal opportunity, to commit crime. Structural factors may also exist which create stressful life situations and consequently push potential criminals to committing crime.

Wilson and Kelling suggest that this behavior-without-consequence ultimately leads to the breakdown of community controls. Residents that care for their homes, look after each other, and overall discourage and fight against “against intruders” does not exist when the general consensus is that the destruction of property is permissible. From there, the effects only snowball: property is abandoned, weeds grow, windows are smashed, adults stop reprimanding rowdy children, who only grow more rowdy, families move out, loitering ensues, litter accumulates, and drunken panhandlers wander the streets. (Wilson and Kelling, 1982)

Charles Branas and Rose Cheney (2011) further this point in their reference to incivilities theory. The theory suggests that “physical incivilities, such as abandoned vacant lots, promote weak social ties among residents and encourage crimes, ranging from harassment to homicide.” The presence of neighborhood incivilities have been linked to the occurrence of numerous crime

types including robbery, homicide, assault, rape, drug dealing, harassment, and burglary. Additionally, resident reports of perceived incivilities have also been linked to an increased perception of crime and an increased perception of fear of crime. (Brown and Perkins, 2004) When residents believe that crime, particularly violent crimes, are rising in their neighborhood, they are more inclined to change their regular behavior: “They will use the streets less often, and when on the streets will stay apart from their fellows, moving with averted eyes, silent lips, and hurried steps.” (Wilson and Kelling, 1982) Branas and Cheney (2011) identify that at the core of all of the theories discussed is the idea “that criminals are thought to feel emboldened in areas with greater physical disorder while, at the same time, residents are driven toward greater anonymity and are less willing or able to step in and prevent crime.” Ultimately, this change in behavior to an introverted, fearful state will result in residents becoming detached from their neighborhood.

Aiyer and Zimmerman cite that criminal behavior typically follows a cycle of property abandonment and urban decay, as can be seen through their research in Flint, Michigan. (2014) A once booming manufacturing city, Flint fell victim to the industrial decline of the mid-20th century. Today, the city’s median income is less than \$26,000, more than half of families live in poverty, and almost one in five homes remains vacant. Structural factors can be measured by concentrated poverty, access to resources, home ownership, and residential stability. These structural characteristics, as well as others, serve as indicators of the stability in a neighborhood. (Aiyer and Zimmerman, 2014)

Further, structural factors influence social processes within the neighborhood in several ways, many of which are interconnected. (Sampson and Morenoff, 2006) Areas of concentrated poverty tend to be limited to critical resources such as public schools, health care facilities,

public parks, and other recreational areas. (W.J. Wilson, 1996) When poor economic conditions like poverty and low annual income persist, access to essential resources have been observed to lead to increased perception of fewer opportunities within one's neighborhood. With limited opportunities, namely employment options, residents experience frustration, dissatisfaction with current situations, stress, and social isolation. (Tolan et al., 2003) Aiyer and Zimmerman note that “as informal social control declines so begets weakening of social cohesion, further exacerbating the process neighborhood decline.” (2014)

Residential stability is another important structural characteristic in evaluating urban social organization. (Kasarda and Janowitz, 1974) It reflects residents’ attachment to their community and facilitates the creation of social networks. Perhaps most importantly, residential stability creates a sense of attachment to place, that is, a deep connection to and feeling of ownership to property and neighborhood. Local ties between residents and other landmarks are supported, and ultimately social cohesion is strengthened. (Sampson and Raudenbush, 1999) In regards to criminal activity, Leventhal and Brooks-Gunn observed that residential stability is intimately related to home ownership, which is linked to less crime. (2000) Even when poverty is factored into equation, “neighborhoods with high levels of residential stability are characterized by higher levels of reciprocated social exchange than unstable neighborhoods.” Unified, close-knit communities foster an inclination to remain in the neighborhood, furthering social cohesion and interpersonal trust. (Sampson and Raudenbush, 1999) Conversely, Skogan (1990) and Taylor (1996) found that instability within a neighborhood is associated with disorganization, isolation, and crime.

Perception of crime also contributes to neighborhood stability and social cohesion. Violent crimes are highly influential in defining neighborhood dynamics. Studies have shown

that violent crimes, specifically robbery and aggravated assault, strongly predict residents' perception of crime, as opposed to property crimes which have very little impact. (Hipp, 2010) Economically, violent crimes reduce neighborhood property values more than property crimes do. (Hipp and Tita, 2009)

A possible solution, therefore, may be to focus on repairing the decaying environment. Kuo and Sullivan (2001) performed two different experiments that demonstrated a significant decrease in intra-family violence and possibly crime when areas in and around public housing were greened. R.V.G. Clarke (1980) explores the idea of crime opportunity, arguing that the two ways to restrict one's opportunity are to either reduce the physical opportunities for offending, or increasing the chances of an offender being caught. Clarke ultimately concludes that it is better to prevent crimes because it keeps more people out of prison and requires less resources than increasing the likelihood a criminal is caught.

While studies, like those conducted by Kuo and Sullivan, have argued that simply greening urban areas can help to reduce crime, this study aims to show that community gardens achieve this in an even greater capacity. Community gardens revive decaying property, bringing a sense of neighborhood pride, while also providing a safe space for social interactions to take place and sustaining a community's values. (Flachs, 2010) Andrew Flachs goes on to outline the many benefits of community gardens. Intra-community economies form as produce is sold between neighbors, helping to encourage a sense of community and encouraging social interactions. Community gardens act as social spaces, similar to parks, where parties, festivals, and picnics can be held. Well-staffed with adults, many of whom are parents, the gardens provide safe spaces for children and families. One garden studied in Flachs' Cleveland, Ohio

study had a community-agreed set of rules that required common courtesies such as cleanliness and child supervision, as well as banning alcohol, drugs, and weapons. (Flachs, 2010)

Community gardens have the ability to “promote communal gardening in social housing communities as a way of improving social cohesion, reducing crime, and promoting health within needy communities.” Steven Paul, coordinator of Community Greening, a Botanic Gardens Trust in New South Wales, reports that his team “could see that [the community gardens were] bringing residents together. There was a social community building capacity coming out of [the gardens]. We have seen a reduction in crime. We have seen ownership of neglected open space.” (Coleman, 2009) With more eyes on the streets and shared ownership of the neighborhood, residents are more likely to report crimes or even to intervene. Further research suggests that beautifying an area alone has the ability to deter potential criminals because it shows that the area is actively managed and that people are around, as opposed to vacant spaces. As indicated in Chapter 1, some studies go as far as to suggest that the mental health benefits of exposure to nature can reduce the occurrence of crime.

With prior studies considered as well as the preliminary research detailed in Chapter 1, we sought to further this area of study. Prior evidence suggesting the abilities of community gardens to improve social cohesion rely on small scale studies or on responses from residents. While this work has been important in progressing the theory, we aim to use the entire Bronx borough to demonstrate that community gardens do in fact have the capacity to deter crime by increasing social cohesion. While this work will still only break the surface of a new field of study, we believe that our findings will prove significant in future experiments.

Data and Methods

Data Sources

Violent crime data was taken from the New York City OpenData and was sourced from NYPD crime logs and their CompStat 2.0 data analytics utility. Once the raw crime and community garden data had been obtained, numerous applications were used to further transform the information. Texas A&M University's geoservice batch reverse geocoding utility was used to first convert the longitude and latitude of violent crimes to street addresses. From there, the street addresses were converted into their respective census tract number using the US Census batch geocoder service. Community garden street addresses were also converted into their respective census tract number using the same service. Lastly, each violent crime and community garden census tract was converted into its respective NTA number manually using US Census databases as reference. The violent crime and community garden data needed to be in the NTA unit of analysis format in order to perform a regression analysis with the ACS information.

The original violent crime data included the longitude and latitude of the crime committed, the date the crime occurred, the crime type, as well as other relevant crime information to the NYPD, but was refined and organized as needed for this study. The violent crime information included rapes, murders, assaults, and robbery, as classified by the FBI's Uniform Crime Reporting Program (FBI), as well as the longitude and latitude of the crime. Crime data was also only included for the Bronx borough that occurred between January 1, 2016 and December 31, 2017. After all of the crime data was compiled, all violent crimes used in this study totaled 8,015.

Community garden data was taken from New York City's Grow NYC website and was recorded manually in order to be used translated through the Texas A&M batch reverse

geocoding tool. Information for this data included the street address, the square footage, and the name of each community garden. There were 108 unique community gardens across all 38 Bronx neighborhoods in this study. Community gardens owned or maintained by schools, churches, or other private entities, as well as public parks or other public green spaces, were not accounted for; that is, only community gardens created by and formally acknowledged by the New York City government were included.

The data for the independent variables was sourced from the New York City Department of Planning website. American Community Survey (ACS) data was taken at the Neighborhood Tabulation Area (NTA) level and included demographic, social, economic, and housing information. Of the 38 Bronx neighborhoods included in the ACS spreadsheet, only the 36 residential neighborhoods were used in this study; excluded are Riker's Island and NTA number 99, which is classified as "parks/cemeteries/etc."

After all data had been obtained, refined, transformed, and organized, the dependent variable used in this study was "crimes per 1,000 people." The main independent variable used was "total community garden square footage per person." The remaining independent variables from the ACS data that were tested included indicators drawn from social cohesion theory, along with socio-demographic characteristics. Specifically, I control for the percentage of people residing in the same house as one year ago per the total population, the percentage of people with less than a high school diploma per the total population, the percentage of vacant housing units per the total housing stock, the percentage of people living below the overtly level per the total population, and the percentage of the neighborhood population that is white.

Statistical Analyses

IBM's data analytics software SPSS Statistics was used to perform the regression analysis. The regression analysis provided important information for analyzing possible correlations.

Results

Sample Description

Of the 38 Neighborhood Tabulation Areas in the Bronx, 36 were looked at in this study, excluding Riker's Island and "parks/cemeteries/etc." The dependent variable used in the regression analyses was violent crimes per 1,000 people. In order to test if the presence of community gardens had any effect on the violent crime rate, we kept total community garden square footage per person as the key independent variable throughout. Other predictor variables included the percentage of the population with less than a high school diploma, the percentage of the population that lived in the same house one year ago, the percentage of the population that is white alone, and the percentage of vacant housing units. Controlling for these indicators should reveal the unique association between community garden presence and violent crime, after controlling for aspects of social cohesion and socio-demographic makeup of neighborhoods.

Table 1 shows the descriptive statistics for each of the variables. The range of violent crimes per 1,000 people ranges relatively far. The minimum value is 2.122 violent crimes per 1,000 people in Co-Op City (BX13) and the maximum is 10.421 in Mott Haven-Port Morris (BX39). Overall, the mean value for violent crimes per 1,000 people across all Bronx neighborhoods is 5.562. The lowest percentage of the population with less than a high school diploma is 8.172% in North Riverdale-Fieldston-Riverdale (BX22), and the highest is 42.485% in Mott Haven-Port Morris. The mean percentage of the population with less than a high school diploma for all of the neighborhoods is 29.05%.

Ethnic demographics among the neighborhoods vary greatly. Claremont-Bathgate (BX01) has the lowest percentage of exclusively white residents at only 2.761%, whereas Pelham Bay-Country Club-City Island (BX10) has the highest percentage at 84.497%. The mean

percentage among all of the neighborhoods is 20.89%, but the variation between neighborhoods is tremendous. Similarly, in terms of relative variation, the percentage of vacant housing units fluctuates quite a bit between neighborhoods. The minimum percentage is 1.977% in West Farms-Bronx River (BX08), while the maximum is 11.755% in Highbridge (BX26). Between all of the neighborhoods, the mean percentage is 6.149%. The difference between the minimum and maximum percentages of people that lived in the same house one year ago is also relatively wide. The minimum percentage is 81.363% in Belmont (BX06), while the maximum is 95.711% in Soundview-Castle Hill-Clason Point-Harding Park (BX09), and the mean percentage is 89.815%.

Table 1: Characteristics of Bronx Neighborhoods

Characteristic	Mean or %
<i>Analytical variables</i>	
Crimes per 1000 People (mean)	5.562
Less than High School Graduate	29.052
Lived in Same House 1 Year Ago	89.815
White Alone	20.890
Vacant Housing Units	6.494
Community Garden Space	0.758
Square Footage per Person (mean)	
N of cases	36
Note: All figures are percentages except where noted.	
Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC	

Total community garden square footage per person is measured on a small scale, and can best be observed as a percentage distribution in Table 2. 12 of the 36 (33.33%) neighborhoods have no community gardens at all, so the minimum value is 0.00. The maximum value, however, is 3.331 square feet of community garden space per person in Soundview-Castle Hill-Clason Point-Harding Park (BX09). Table 2 shows that the top 25% of neighborhoods have at least 1.316

of community garden square footage per person. When looking at which neighborhoods are within this top 25%, many of them tend to be the neighborhoods with the most amount of gardens as well as relatively high crime rates. For instance, Mott Haven North has 17 community gardens and 3.014 square feet of community garden space per person and the second highest violent crime rate of all of the neighborhoods in the Bronx. This could potentially be explained by our hypothesis that community gardens deter crime in places with high crime rates. Soundview-Castle Hill-Clason Point-Harding Park (BX09) has the most community garden space per person, but also one of the lowest violent crime rates. Perhaps the presence of community gardens in the neighborhood has helped to keep the crime rate low.

Hypothesis Analysis

A regression analysis was first run predicting the violent crime rate as a function of total community garden square footage per person (Table 2, Model I), and subsequent models added control variables individually, while a “full” model completed the analysis (Table 2, Model II). Model I yielded an adjusted R-square value of .138, indicating that garden space per person explains 13.8% of the population. However, the unstandardized slope for total community garden square footage per person had a P-value of 0.15, indicating that, contrary to expectations, neighborhoods with more community garden space have more violent crime. While our hypothesis predicted a negative correlation between community gardens and the violent crime rate, our analysis suggests the opposite: a significant, positive correlation.

Model II shows the regression analysis including all independent variables. The effects that each of the variables had on the crime rate were consistent with our expectations. Living in the same house as one year ago had a negative correlation with the violent crime rate, meaning

that high retention of a household, an indicator of neighborhood stability, which is an indicator of overall social cohesion, helps to decrease the violent crime rate. The percentage of vacant housing units had a positive correlation with the violent crime rate, a further indication of neighborhood stability. Further, the percentage of residents that are white alone had a negative correlation on the violent crime rate. This may suggest that non-white populations could actually have a positive correlation with violent crime. While the significance levels for each of these independent variables may not be substantial, the data indicates that these relationships to the violent crime rate do exist as anticipated.

Table 2: Results of OLS regression models predicting violent crime rates in Bronx Neighborhoods

Predictor	Model I		Model II	
	b	β	b	β
Community Garden Space	0.765 *	0.403	0.323	0.17
Square Footage per Person				
Lived in Same House 1 Year Ago			-0.192	-.221
Less Than High School Graduate			0.145 ***	.647
Vacant Housing Unit			0.017	.015
White Alone			-0.003	-.040
Constant	4.982		18.283	
adj. R ²	.138		0.527	
# cases	36		36	

* p <= .05; ** p <= .01; *** p <= .001.

Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC

The percentage of the population that has less than a high school diploma is significantly correlated with the violent crime rate, more so than any of the other variables. In fact, controlling for the percentage of people with less than a high school diploma actually reduces the

significance of the effect of community garden square footage per person on the violent crime rate, which was observed in Model I. A less educated population is an indicator of socioeconomic health in a neighborhood. As can be seen in Model II, it's clear that a high percentage of the population with less than a high school diploma is highly correlated with the violent crime rate. This suggests that perhaps increased community garden space does not drive violent crimes, but a large population of uneducated and presumably poor residents does instead.

When considering the effects of community gardens and their emergence in the Bronx overtime, the data suggests that they don't necessarily reduce the violent crime rate, but instead could have developed as a response to it. Mott Haven North (BX34) has historically been one of the poorest neighborhoods in the country. The Bronx's notoriously high crime rates since the 1970s have been concentrated in Mott Haven, yet it also has 15 community gardens, more than three times as many gardens as most any other neighborhood. Perhaps a high percentage of people living below the poverty line, a significantly large share of vacant properties compared to other Bronx neighborhoods, a small white population, and over 42% of the population with less than a high school diploma have driven violent crimes over time, thus triggering the addition of community gardens over time.

Controlling for each of the independent variables individually against community garden space per person and the violent crime rate shows the effect of each respective independent variable. Appendix A furthers the point that high percentages of the population living in the same house as the year before alone, that is, high neighborhood stability, maintains a negative correlation with the violent crime rate, while a large amount of community garden space per person remains highly significant. A high percentage of vacant housing units, an indicator of low neighborhood stability, still has a positive correlation with the violent crime rate, however the

correlation isn't significantly strong. (Appendix C) Still, the community garden space per person remains significantly correlated with the violent crime rate.

The percentage of the population with less than a high school diploma still remains the most significant independent variable in its effect on the violent crime rate, rendering the community garden space per person insignificant. (Appendix B) The percentage of the population that is white alone, however, may be more significant than originally thought from the regression data in Table 2. A negative correlation still remains between the "white alone" population and the violent crime rate, although when used as the only control in the regression analysis the significance becomes apparent. Community garden space per person is no longer a significant correlation. While Model II in Table 2 does not show the white alone population as being a significant factor in mitigating the violent crime rate, Appendix D demonstrates that the "white alone" population may play an important role alongside the percentage of the population that has less than a high school diploma in reducing the violent crime rate.

Study Limitations and Future Questions

Certain limitations may have affected the accuracy of data over the course of this study. While the crime data is sourced from the NYPD and their CompStat 2.0 program, it was provided through an opensource website. This means that the data is not directly provided by the NYPD, but is instead replicated by a possibly unaffiliated individual, and may be subject to inaccuracies. Data points were randomly selected and manually checked to verify the location of the crime and the latitude and longitude points aligned with the street addresses, but this may not be true of all 8,015 crimes. Similarly, ACS data is subject to a greater margin of error than the decennial national census, but using neighborhoods rather than census tracts minimizes the potential bias from such error.

Future work should expand the scope of the study. First, examining the data over a longer time period would provide more meaningful data. While the time of record keeping that exists today with the NYPD is relatively modern, going back as far as possible would better demonstrate how crime trends have changed in New York over time, as well as how land use and community garden creation have changed. It would also be interesting to observe how the presence of community gardens affects other types of crime aside from violent crimes. This may be harder to measure as a direct correlate, but it would still be interesting to see.

Finally, an aspect of environmental criminology that we believe is important to the study as a whole is the mental and physical health benefits of exposure to green spaces. Few studies have been conducted to this end, but tying that into the occurrence of crimes in urban areas could be enlightening to the field of study.

Conclusion

The question of what drives the occurrence of crime is a difficult question to answer, but an important one to consider as cities continue to grow. Theories have been proposed that claim people commit crime for economic, social, and mental health reasons, but the topic is not so black and white. Instead, the motives to commit violent crime are likely a combination of many things, and resolving them together is a difficult and expensive venture for any government to undertake. While pioneering theories, like Wilson and Kelling's Broken Windows Theory, helped to drastically reduce crime rates within a short period of time, they did little to address the sources of the problem. The concept of social cohesion, though, contemplates all aspects of a community. Thinking about the overall health of a society as more than just the poverty level or unemployment rates may help to effectively reduce crime rates.

When considering the social cohesion of a neighborhood, we thought about what helps to build a communal mindset. Crime is allowed to run rampant when people stop caring for their property, their surroundings, and each other. An innovative approach to potentially alleviating crime in urban places could be community gardens. Providing a public space for neighbors to engage with each other fosters trust, familiarity, and caring for one another and for a common space. By instilling feelings of safety and trust within a community, the residents become empowered and self-police, in a way. They are less likely to turn the other way when a crime is being committed and more likely to speak up when an outsider, or even a neighbor's child, appears suspicious. With all theories considered, we ultimately went into this study anticipating that the presence of community gardens in the Bronx would have a crime mitigating effect.

After analyzing our data, however, it appears that community gardens have instead emerged in the Bronx as a response to high crime rates. While the social cohesion effects of a

community garden still hold true, our findings suggest that there may be other factors that drive violent crimes than simply a lack of trust. Certain aspects of social cohesion, like socioeconomic and housing components, carry significant weight in driving the violent crime rate. The most notable finding from the study shows that a high percentage of people that have less than a high school diploma is significantly correlated with the violent crime rate. An uneducated populace is a sign of a poor socioeconomic class, on account of potential high-earning job opportunities that cannot be attained without a higher education.

Additionally, the percentage of the population that is white alone also appears to play a significant role in reducing the crime rate. This finding is slightly more difficult to explain, but white people generally have had less social barriers to overcome in life compared to minority groups. While the presence of white people in Bronx neighborhoods may not directly reduce the violent crime rate, a greater proportion of whites may mean that overall social, economic, and housing opportunities are greater, thus the potential to commit crime is reduced. Further, if we assume that, in the Bronx, whites in general have more social opportunities and better access to resources than non-whites, then perhaps this opens the window for greater care for community gardens as an extra expense. While more research would need to be conducted in the future to reinforce this point, our finding is significant in showing what reduces violent crimes.

Future work will ideally examine a place, like the Bronx, on a longer time frame and will include more independent variables in the study. While high school education and a white population are certainly not the only significant indicators in reducing violent crimes in the Bronx, it's clear that they are important and should be considered when determining public policy. Lastly, the presence of community gardens in these spaces are important in many regards, one of which, no matter the level of their impact, is their ability to reduce the occurrence of crimes.

Appendices

Appendix A

Appendix A: Results of OLS regression models predicting violent crimes rates in Bronx Neighborhoods

Predictor	Model I	
	b	β
Community Garden Space	0.971 **	0.512
Square Footage per Person Lived in Same House 1 Year Ago	-0.259	-0.299
Constant	28.129	
adj. R ²	.194	
# Cases	36	

* p <= .05; ** p <= .01; *** p <= .001.

Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC

Appendix B

Appendix B: Results of OLS regression models predicting violent crime rates in Bronx Neighborhoods

Predictor	Model I	
	b	β
Community Garden Space	0.161	0.085
Square Footage per Person Less than High School Graduate	0.158 ***	.705
Constant	0.855	
adj. R ²	.532	
# cases	36	

* p <= .05; ** p <= .01; *** p <= .001.

Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC

Appendix C

Appendix C: Results of OLS regression models predicting violent crime rates in Bronx Neighborhoods

Predictor	Model I	
	b	β
Community Garden Space	0.755 *	0.398
Square Footage per Person		
Vacant Housing Units	0.027	.024
Constant	4.827	
adj. R ²	.112	
# cases	36	

* p <= .05; ** p <= .01; *** p <= .001.

Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC.

Appendix D

Appendix D: Results of OLS regression models predicting violent crime rates in Bronx Neighborhoods

Predictor	Model I	
	b	β
Community Garden Space	0.476	0.251
Square Footage per Person		
White Alone	-0.029 *	-.348
Constant	5.806	
adj. R ²	.216	
# cases	36	

* p <= .05; ** p <= .01; *** p <= .001.

Note: Data used was sourced from the 2012-2016 ACS, NYC OpenData, and GrowNYC.

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