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11-22-2021

Counteracting Crime or Wasting Time? Examining a Blight Abatement CPTED Project in Philadelphia

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COUNTERACTING CRIME OR WASTING TIME? EXAMINING A BLIGHT ABATEMENT
CPTED PROJECT IN PHILADELPHIA

A Thesis
Presented to
The Faculty of the Department of Sociology
Western Kentucky University
Bowling Green, Kentucky

In Partial Fulfillment
Of the Requirements for the Degree
Master of Sociology
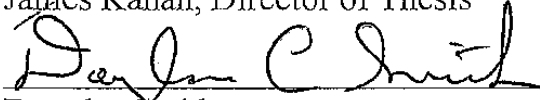
By
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2021

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CPTED PROJECT IN PHILADELPHIA

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Dedication

This project is dedicated to my partner, Colin, without whose constant support this thesis wouldn't have been possible. Even when I don't believe in myself, he has always believed in me and supported me to being the best version of myself possible. This project is also dedicated to my family, for showing me that I can succeed despite anything life puts me through.

Acknowledgments

I would like to express my sincere thanks and gratitude to my chair, Dr. James Kanan for his support and guidance while completing my project. I am ever thankful to Dr. Musalia for his help with the methods section of my thesis. Additionally, I am thankful to both Dr. Smith for his wisdom and guidance, and Dr. Vasiliev for his insight, in the beginning iteration of this project

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Directed by: James Kanan, Doug Smith, and Pavel Vasiliev

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This study examines the relationships between a blight abatement CPTED project and the total, violent, and property crime rate in Philadelphia from 2000-2019. After controlling for certain demographics (population, median household income, median age of population, poverty level, and unemployment rate) as well as the national crime rate, no statistically significant relationship was found between the CPTED project and the crime rates with the data and measurements available to the researcher.

Introduction

This study examines the concept of crime prevention through environmental design (CPTED); the usage of the natural and built environment to reduce the opportunity and fear of crime. CPTED takes many forms, ranging from CCTV camera usage to proper lighting in an area, and from carefully choosing entrances and exits to a space, to upkeep and maintenance of properties. Understanding how and why CPTED is employed is becoming increasingly relevant as more than half of the world's population has become urbanized and that number is expected to continue increasing (United Nations, 2010). CPTED, when properly designed and used, can lead to "a reduction in the fear and incidence of crime, and an improvement in the quality of life" (Crowe, 2000) for those in ever-expanding urban areas.

CPTED as referenced in this study will use the definition presented in *Crime Prevention through Environmental Design: Applications of Architectural Design and Space Management Concepts* (Crowe, 1991). Here, Crowe defines CPTED as ''the proper design and effective use of the built environment [that] can lead to a reduction in the fear and incidence of crime, and an improvement in the quality of life.'' CPTED is a strategy used by law enforcement, city planners, architects, community service organizations, and other entities to reduce the inherent opportunity for crime through the manipulation of the structure or design of the neighborhood.

Through research and development over prior decades (Jacobs, 1961) and (Newman, 1973), CPTED has been broken down into four main concepts: natural surveillance, natural access control, natural territorial reinforcement, and maintenance. The demarcation of these four concepts is most often attributed to Oscar Newman (1973) in his book *Defensible Space; Crime Prevention Through Urban Design,* where the four design elements are first defined. These four elements work both individually and in combination with each other to make urban spaces a

safer space. With each concept definition, it is clear how the concepts are all individual but broadly overlap with each other. Natural surveillance consists of improving visibility through the placement of physical features and activities that maximize the natural visibility of the space and the users inside the space. Natural access control consists of denying any potential offenders' access to a possible target through selectively planning entrance and escape routes to reduce escape opportunities and guiding legitimate users of the space through the environment. Natural territorial reinforcement consists of clearly designating a space as public, semi-public, or private to create a sense of the appropriate ownership of the space. This can be done through things like displaying security system signage or using motion sensor lights to create a sense of ownership in the minds of the users of the space. Maintenance is an important part of natural territorial reinforcement that consists of ensuring the property does not go into a state of disrepair, this expresses ownership of the space as well.

When city governments enact policies and ordinances in a concentrated effort to lower crime, citizens in that city often report improved physical and mental health (Garvin, Branas, Keddem, Sellman, & Cannuscio, 2012), and cities often report decreases in crime in the areas where the project was implemented (Chalfin, Hansen, Lerner, & Parker, 2017). These projects are often very costly and require months or years of work and planning to complete (Morgan, Anderson, & Boxall, 2014). Considering the high cost and length of time and planning required for CPTED projects, a measurable change in the crime rates for the city of implementation should be observed for the costs and benefits of CPTED to be justifiable. If these implementations are not actually reducing crime and just making people feel safer, are the measures a waste of time and money for that city that could be using those resources to improve other aspects of life? This study will examine if a blight abatement CPTED project has been

effective at reducing or deterring crime by measuring the crime rate in Philadelphia for eleven years before the implementation of the ordinances and nine years after the ordinances were enacted.

<div align="center">**Literature Review and Theory - The Many Faces of CPTED**</div>

Crime prevention through environmental design (CPTED) is a topic that branches over many disciplines including but not limited to, criminology, sociology, architecture, design, city planning, economics, community outreach, and public health and medicine. All these disciplines have an interest in CPTED and with that interest comes many different types of studies and literature on the topic that have helped the development of the concept of CPTED to what it is today. CPTED is rooted in architectural design as most of the early development of CPTED was done from an architectural perspective (Newman, 1973). Newman studied the architecture of two housing projects in New York and found significantly higher crime rates for the housing constructed as a high-rise (Van Dyke) compared to the housing constructed as lower leveled (Brownsville). Newman posited that the tenants within each housing were similar and the difference in the crime rates could be attributed to the architectural differences in the buildings. The Van Dyke project had long, winding hallways and little-to-no surveillance and these areas were where more than half of the reported crimes were committed. This research paved the way for architects to begin examining and changing how the spaces they construct can affect what happens within those spaces: if architects can understand ways to reduce crime or to make pathways visible, they can effectively implement CPTED naturally without needing additional reconstruction. There are guides and resources (Crowe & Fennelly, 2013; Pauls, et al., 2000) available with information on the best approaches for architects and city engineers to use when designing cities and spaces to naturally reduce crime itself and the fear of crime.

CPTED also has roots in the public health and medicine disciplines in efforts to help understand, explain, and combat the effect of crime on the public's health and safety. One of the main ways most cities begin CPTED is to begin to renovate and care for vacant properties and abandoned houses. About 15% of the land in the United States is vacant or abandoned, totaling over 74 million acres of space that can be used more beneficially (Branas, et al., 2016; Kondo, et al., 2018). Research has shown that remediating vacant lots, abandoned buildings, and greening (transforming the space into a more environmentally friendly space like community gardens and parks) have had a significant effect in reducing drug and firearm crimes in the neighborhoods implementing these policies (Branas, et al., 2016; Kondo, et al., 2018). Urban health research has also shown that vacant land invokes negative emotions ranging from "sadness and depression… [to] anger and frustration over feeling powerless to change the physical condition of their neighborhood" (Garvin, Branas, Keddem, Sellman, & Cannuscio, 2012). This study showed that vacant land evoked negative emotions like "anger and frustration over feeling powerless to change the physical condition of their neighborhood." (Garvin, Branas, Keddem, Sellman, & Cannuscio, 2012). Additionally, participants in the study expressed negative amotions regarding vacant land and children in their community; "Some participants were anxious about the harmful exposure children might experience playing on vacant land." (Garvin, Branas, Keddem, Sellman, & Cannuscio, 2012). Participants also expressed to the researchers that they felt their community was unfairly judged and stigmatized by outsiders due to decaying, abandoned, or vacant property. This research also shows that residents in communities with vacant land also felt their physical and mental health was affected through trash buildup, rodent attraction to the trash, injuries, and both anxiety and the perceived stigma surrounding the vacant areas in their

neighborhood. This anxiety and stigma can affect the number of residents transitioning in and out of the city, and the overall economics of the city.

Research has shown that the number of residents transitioning in and out of a city; foreclosures and vacant land or buildings have an impact on the economics, and in turn, the amount of crime in those neighborhoods (Ellen, Lacoe, & Sharygin, 2013). When residents have anxiety and feel their neighborhood is stigmatized due to vacant land and abandoned buildings, they may not want to stay in that area, and they may not care enough to help keep their community clean and safe or make their home more permanent. This research is representative of Social Disorganization Theory stating that a person's physical and social environment is more responsible for someone committing a crime as opposed to individual's behavior. According to Shaw and McKay, neighborhoods with higher crime rates had at least three problems in common: physical dilapidation, poverty, and higher level of ethnic and culture mixing (Shaw & McKay, 1942). These factors were indicative of a highly disorganized community and would have higher crime rates than more organized communities. This tie of crime to the physical environment was also found in *Do foreclosures cause crime?* Here, Ellen, Lacoe, & Sharygin (2013) discovered that the number of foreclosures in a blockface (a street segment that includes properties on both sides of the street, aka, a block) in New York City affects the amount of total crime, violent crime, and public orders crime in that blockface.

Several studies have been conducted to show how CPTED affects the community, feelings of belonging and togetherness. One study completed in Pittsburgh showcased how the Penn Avenue Art Initiative (PAAI), implemented in 1998, has revitalized a formerly derelict street in the city. The city began using the boarded-up store spaces to allow artists to paint murals, open art galleries and community service organizations, have classes, daycare for

children, and restaurants in the area that formerly had high levels of crime (Walker & Engh, 2017). Over 15 years, PAAI created an economic cluster surrounding arts and arts-related businesses that bring the community together through pooling resources and shared interests. Additional research on four cities that implemented "creative placemaking" to revitalize vacant properties showed that, while there are challenges and regulatory barriers to initiating programs to aid the community, the benefits bring the community together and can serve as a lesson to other cities to implement revitalization efforts (Engh, Fitter Harris, Gadwa Nicodemus, Lewinski, & Allinger 2018).

While on the surface, revitalization may sound very similar to gentrification, the difference lies in the purpose and intentions behind the revitalization of the neighborhoods. The National Low-Income Housing Coalition summarizes the difference between revitalization and gentrification in their 2019 publication *Gentrification and Neighborhood Revitalization: WHAT'S THE DIFFERENCE?* Stating that while gentrification's goal is to drive out lower class residents in the area in an attempt to get land as cheap as possible to create an urban area with more middle-class tenants that earn more and are more willing to pay higher rents, the goal of community revitalization is to encourage sustainability and health within the community and the goal is to benefit all residents in the community, regardless of income, race, or class. They conclude that race is inherently concurrent with gentrification attempts as most of the middle-class is white while people of color usually have less income so they cannot pay the higher rent prices and are at greater risk of eviction. They state that positive neighborhood development should value longtime residents' views of the neighborhood, it should help community members with identifying housings, services, and infrastructure that is available in their neighborhood.

The developmental process should give decision-making power to community residents and foster a sense of pride in the community that leads to positive change.

As stated above in the public health and medicine section, one of the main ways most cities try to begin implementing CPTED is to care for and renovate abandoned buildings and vacant properties. This idea stems from a criminological theory proposed in 1982 by George Kelling in an article for *The Atlantic Monthly* titled "Broken Windows." This theory posits that if a house has one broken window that is left unattended to, soon all the windows in the house will be broken as well. The idea focuses on the premise that broken windows signify no one cares about that property, thus that neighborhood lacks informal social control and cohesiveness. Criminals see this disrepair and feel they can commit crime in that area, even if it is a nice neighborhood (Kelling & Wilson, 2018). Also, many cities have implemented street lighting changes to help naturally deter crime, although some studies have shown that the impact of adding more lighting or choosing the lighting placement is difficult to measure accurately (Clarke, 2008). Other studies that show "robust crime reduction[s]" (Chalfin, Hansen, Lerner, & Parker, 2017) in areas where randomized experimental lighting was temporarily set up to measure effects on index crimes, felony, and person crimes.

Additionally, CPTED encompasses many areas of sociological theories on the community, reducing crime, and increasing the safety of residents. Many policies implemented by cities attempt to deter the appearance of disrepair to combat crime. One study shows that Newburgh, NY, Wilkinsburg, PA, and Flint, MA require owners of boarded-up properties to artistically paint over the boards to combat the decrepit look of rotting boards over windows or doors (Engh, Fitter Harris, Gadwa Nicodemus, Lewinski, & Allinger 2018). Other cities implement policies requiring owners to remove rotting or deteriorating boards from abandoned

buildings and replace them with working windows and doors under penalty of large fines (Branas, et al. 2016). Many of these policies are implemented with the idea of social disorganization theory in mind. This theory was introduced in 1942 by Clifford Shaw and Henry McKay in their article *Juvenile Delinquency and Urban Areas: A Study of Rates of Delinquents in Relation to Differential Characteristics of Local Communities in American Cities.* They found that crime seemed to be concentrated in certain areas of the city and that despite the population transitioning in and out of the area over time, the crime rate remained stable. The authors deduced that the high crime rate in some areas was a function of the dynamics of the neighborhood itself rather than the individuals within the neighborhood (Shaw and McKay, 1942). Much like the Broken Windows theory discussed previously, this theory focuses on the environment of the neighborhood rather than the people inside the neighborhood and proposes the solution to the high crime rate is to improve the environmental conditions in those high crime neighborhoods.

The wide net that CPTED casts shows that it is becoming quite an impactful practice and more cities enact policies that employ natural crime prevention within the foundations of the projects. It is important to understand the range of genres that CPTED covers so that we can understand to look at the environment around us differently. If one tried to focus on CPTED through only a sociological lens, there would be important discoveries and foundations located in architectural or public health sectors, for example. As Timothy Crowe (p. 5, 2001) states, "Each profession is trained to focus attention on its unique objectives. For instance, police officers are trained to look at openings - doors and windows. Not until they have had CPTED training do they begin to see the property, as it was intended to be." To understand the origins and development of the concept of CPTED, the full literature must be examined and reviewed.

In 2018, there were more than 40,000 vacant lots of land within the city limits of Philadelphia (Loesch, 2018). The City of Philadelphia contracted the Pennsylvania Horticulture Society (PHS) to aid in finding a solution to the vast amount of vacant and blighted properties in the city. The solution, known as The Landcare Program, cares for approximately 12,000 lots within the city, roughly 30 percent of the lots in the city (Loesch, 2018). According to Loesch, the initial cost for a cleanup of a vacant lot is $1,500 and bi-monthly maintenance of the property averages $300 each year, per property. In total, the PHS receives $6.5 million annually as part of their contract to "green" the vacant land in Philadelphia. This study seeks to examine the effects of the CPTED project to conclude if the results of the project are standardizable or reproducible as a possible guideline for other cities.

Methods

Cities Examined

This study will examine if the implementation of a blight abatement CPTED project in Philadelphia has had an impact on the crime rate since it was implemented in 2010. This will be done by examining the crime rate in Philadelphia from the years 2000-2019 and comparing the crime rates from the period before and after the CPTED project was enacted. This study uses the implementation of CPTED as the independent variable, and the crime rate derived from the UCR data is the dependent variable that may or may not be affected when the CPTED is implemented. Statistical Software (SPSS) was utilized to complete a multivariate regression using the independent variable, dependent variable, and various chosen potential predictors. The study will examine if the blight abatement CPTED projects have any effect on the total, violent, and property crimes in the cities.

Data

The data utilized in this study for measuring the blight abatement CPTED project were collected from the city planning page and city website where publicly available information on the project are public. The information collected consists of the year of implementation of the CPTED measures and the type of CPTED measure that were enacted. The data collected for the dependent variable (crime rate) were collected from the Uniform Crime Report data compiled by the FBI. The UCR collects statistics on violent crime and property crimes as well as arson statistics, the crime statistics, and law enforcement officers killed and assaulted on duty. These data are collected yearly, and the FBI publishes four annual reports of this data on their website. Table 1 provides the data used for performing this analysis.

Table 1. Philadelphia crime rates, demographics, and project dummy assignment between 2000 and 2019

Year	Total Crime Rate	Violent Crime Rate	Property Crime Rate	Population	Median HH Income	Educational Attainment	Unemp Rate	Home Own. Rate	Poverty Level	Project Dummy
2000	6457.8	1503.2	4954.6	1517550	30720	24.3	5.5	74.7	18.5	0
2001	6183.1	1409.7	4773.4	1518302	29946	25.8	6.1	74.3	19.5	0
2002	5471.1	1315.9	4155.2	1524226	29540	26.1	7.4	74	20.3	0
2003	5553.4	1378.4	4175	1495903	30517	24.8	7.5	73.7	20.2	0
2004	5513.5	1408.3	4105.2	1484224	30892	25.3	7.3	74.9	21.6	0
2005	5569.1	1467.1	4102	1472915	32671	26	6.7	73.3	24.2	0
2006	5837.5	1562.5	4275	1464576	33368	26.6	6.2	73.2	25.1	0
2007	5780.1	1475.4	4304.7	1435533	35431	25.8	6.1	72.9	23.8	0
2008	5783.8	1441.3	4342.5	1441117	37090	26.6	7.1	72.6	24.1	0
2009	4849.5	1238.2	3611.3	1547605	36959	26.4	9.8	72.2	25	0
2010	5001.5	1214.6	3786.9	1526006	34667	27.1	10.6	72.2	26.7	0
2011	5087.6	1193.3	3894.3	1530873	34433	27	10.7	71.1	28.4	1
2012	4863.7	1160.1	3703.6	1538957	35518	27.8	10.9	71	26.9	1
2013	4540.8	1099.3	3441.5	1553153	36918	28.7	10.3	71.5	26.3	1
2014	4409.1	1021.4	3387.7	1559062	39037	29	8.1	69.7	26	1
2015	4176.3	1029.0	3147.4	1567810	41210	29.7	7.1	69.6	25.8	1
2016	4129.5	988.9	3140.6	1570826	41514	30.8	6.7	68.5	25.7	1
2017	4011.1	947.6	3063.5	1575595	40193	31.4	6.2	68.6	25.7	1
2018	4005.6	908.7	3096.9	1586916	46149	31.8	5.5	69.9	24.5	1
2019	4110.9	953.1	3157.8	1584064	47474	32.3	5.6	69.2	23.3	1

Dependent Variables

Crime rate. Using the FBI's Uniform Crime Report data available on their website, the population of the city and the number of crimes reported were collected. The data are split into violent crimes (murder, non-negligent manslaughter, aggravated assault, robbery, and rape), property crimes (burglary, larceny-theft, and motor vehicle theft), and total overall crime (all violent and property combined). Using the population of Philadelphia along with the total crime numbers, violent crime counts, and property crime counts, the total crime rate, violent crime rate, and property crime rate were calculated for the city by dividing the number of reported crimes by the total population. This result is multiplied by 100,000 and the resulting number is the crime rate for that year in that city creating a standardized rate that can be generalized and compared. The crime rate was calculated beginning in 2000 and recorded until 2019 for a total of twenty years of data.

Independent Variables

CPTED project. Philadelphia passed an ordinance that began in 2011 requiring the owners of "foreclosed vacant residential properties" to keep "all doors, windows and openings from the roof or other areas in good repair." The ordinance also required of property owners; "such doors or windows or entrance to openings are readily accessible to trespassers, they shall be kept securely locked, fastened or otherwise secured." (City Council of Phila. 2011). In addition to the ordinance being passed, Philadelphia contracted the PHS to overtake care for lots that have become property of the city of Philadelphia and private properties that are in violation of the ordinances. The properties cared for by the Landcare Program are chosen based on complaints from community members. In addition to the complaints, the lot's proximity to buildings of interest for the city; "Lots near commercial development and schools are given priority" (Loesch,

2018). A dummy variable was assigned to the CPTED project with 0 indicating the project was

not enacted yet and 1 indicating the project was active. Other types of CPTED projects were not

included in this study due to being unrelated to blight abatement.

Control Variables. Several control variables that could possibly influence the dependent

variable were collected. The control variables include population size, income (calculated as the

median household income for the city), the educational attainment for residents (measured as the

percent of persons over the age of 25 who have at least a Bachelor's degree), homeownership

rate (measured on the state level as those who occupy a housing unit owned by themselves),

unemployment rate (measured as a yearly average) for the city, and the poverty level (measured

as the percent of residents living below the federal poverty level). The data for these control

variables was gathered from the Census website archives. These variables were chosen for their

known correlation to changes in crime rate. Prior research (Nolan, 2004) has established that

population size and crime rates have a significant positive relationship. "... therefore, as the

population size rose in these cities, one would expect to find higher crime rates" (Nolan, 2004).

Additionally, studies (Levitt, 1999) have noted that crime victimization is becoming increasingly

concentrated towards poor neighborhoods. Both poverty and income levels are linked to higher

rates of crime victimization, some studies have shown more than double the rate of violent

victimizations for those in a household below the Federal Poverty Level compared with persons

in high-income households (Harrell et al, 2014). Studies have also shown unemployment rates

have a strong effect on property crimes (Raphael & Winter-Ebmer, 2001). Additionally, the

national crime rate for each category (total, violent, and property) was added as a control

variable to control for the natural decline in crime.

Analysis

The research methodology for this study is based on statistical analysis, a multiple regression analysis. Multiple regression is an extension of regression analysis that allows the measurement of the relationship between a dependent variable and several independent variables. The dependent variable (crime rate) is divided into three sections for more precise analysis: violent crime rate, property crime rate, and total crime rate which is a combination of violent and property crimes. The independent variable of interest is the CPTED project, and the added control variables tested were population, median household income, median age of population, unemployment rate, and poverty level.

Firstly, the necessary data for analysis was presented, from that the regression equation was derived. All data was processed using SPSS - Statistical Package for Social Sciences software. The regression was run three times, once with total crime rate as the dependent variable, once with violent crime rate as the dependent variable, and once with property crime rate as the variable. A one-year lag was introduced to the control variables (population, median household income, educational attainment, homeownership rate, unemployment rate, national crime rate [total, violent, and property], and poverty level) to account for correlation between predictors influencing the variables the year after they are introduced. In addition to the multiple regression, the Durbin Watson statistic was input as well to detect if there was autocorrelation present in the residuals once the one-year lag was introduced. Autocorrelation refers to the possibility that there is similarity among the variables due to the function of the time lag between them. Durbin-Watson statistics range from zero to four, and ideally the resulting statistic should be as close to two as possible, indicating little-to-no autocorrelation is present among the study variables. SPSS was utilized for the multiple regression and the results are displayed in Table 2:

Philadelphia Violent Crime Rate	Unstandardized coefficients		Standardized coefficients		

Table 2. Regression Coefficients

Philadelphia Total Crime Rate	Unstandardized coefficients		Standardized coefficients		
	B	Standard error	Beta	t	Sig.
(Constant)	-14455.209	11679.506		-1.238	.244
Population	.004	.003	.283	1.534	.156
Median HH income	-.004	.065	-.027	-.067	.948
Educational Attainment	-228.838	91.274	-.709	- 2.507	.031
Homeownership rate	208.621	88.151	.589	2.367	.040
Unemployment rate	-229.372	62.134	-.591	-3.692	.004
Poverty rate	166.651	59.812	.649	2.786	.019
Project dummy	160.453	372.444	.115	.431	.676
National Total Crime Rate	.488	1.094	.358	.446	.665

Dependent Variable: Total crime rate

	B	Standard error	Beta	t	Sig.
(Constant)	-1457.956	2839.536		-.513	.619
Population	.000	.001	.028	.166	.872
Median HH income	-.018	.011	.401	-1.751	.111
Educational Attainment	-34.377	26.234	-.364	-1.310	.219
Homeownership rate	56.141	25.120	.542	2.235	.049
Unemployment rate	-58.081	20.167	-.512	-2.880	.016
Poverty rate	43.074	16.165	.574	2.665	.024
Project dummy	-137.231	99.957	-.336	-1.373	.200
National Violent Crime Rate	-1.130	1.512	-.278	-.747	.472

Dependent Variable: Violent crime rate

Philadelphia Property Crime Rate	Unstandardized coefficients		Standardized coefficients		
	B	Standard error	Beta	t	Sig.
(Constant)	-9153.612	10451.279		-.876	.402
Population	.004	.003	.324	1.416	.187
Median HH income	-.016	.060	-.141	-.270	.793
Educational Attainment	-202.971	81.672	-.871	-2.485	.032
Homeownership rate	166.638	78.274	.651	2.129	.059
Unemployment rate	-178.796	54.909	-.637	-3.256	.009
Poverty rate	110.605	53.474	.596	2.068	.065
Project dummy	132.519	319.190	.131	.415	.687
National Property Crime Rate	.021	1.106	.019	.019	.985

Dependent Variable: Property crime rate

The goal of this analysis is to know if the CPTED project influences the crime rates, and if it does, to what extent does the relationship have influence on the crime rate. After obtaining the results from SPSS, the regression equations, based on nonstandard coefficients, obtained are displayed in Table 3:

Table 3. Philadelphia regression equations

Philadelphia
Total crime rate	$\hat{y} = -14455.209 + .004_{x1} - .004_{x2} - \underline{228.838_{x3}} + \underline{208.621_{x4}} - \underline{229.372_{x5}} + \underline{166.651_{x6}} + 160.453_{x7} + .488_{x8}$
Violent crime rate	$\hat{y} = -1457.956 + .000_{x1} - .018_{x2} - 34.377_{x3} + \underline{56.141_{x4}} - \underline{58.081_{x5}} + \underline{43.074_{x6}} - 137.231_{x7} - 1.130_{x8}$
Property crime rate	$\hat{y} = -9153.612 + .004_{x1} - .016_{x2} - \underline{202.971_{x3}} + 166.638_{x4} - \underline{178.796_{x5}} + 110.605_{x6} + 132.519_{x7} + .021_{x8}$

Where $x1$ = population, $x2$ = median household income, $x3$ = educational attainment, $x4$ = homeownership rate, $x5$ = unemployment rate, $x6$ = poverty level, $x7$ = the project dummy variable, and $x8$ = the national crime rate comparison (total, violent, or property). The null hypothesis is $H0 = \beta1 = \beta2 = \beta3 = \beta4 = \beta5 = \beta6 = \beta7 = \beta8 = 0$ and the alternative hypothesis is $H1$ = not all β are equal to 0. Significant variables are denoted by underlined font in Table 3.

Table 4. Model summary

Model	R	R Square	Adjusted R Square	Std. Error of Estimate	Durbin-Watson
Total Crime Rate	.978[a]	.957	.922	200.4753259	2.588
Violent Crime Rate	.977[b]	.955	.920	59.38486578	2.554
Property Crime Rate	.967[c]	.935	.883	177.0356322	2.161

a. Predictors: (Constant), national total crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population
b. Predictors: (Constant), national violent crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population
c. Predictors: (Constant), national property crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population

The coefficient of determination (R^2) indicates the percent of the total variance can be explained by the independent variables. Table 4 presents the total crime rate R^2 of 95.7%, violent crime R^2 is 95.5%, and the property crime rate's R^2 is 93.5%. These indicate that most of the total variance was generated by the regression equations completed.

Table 5. ANOVA – Analysis of Variance

Model		Sum of Squares	df	Mean Square	F	Sig.
Total Crime Rate	Regression	8839301.659	8	1104912.707	27.492	.000[a]
	Residual	401903.563	10	40190.356		
	Total	9241205.222	18			
Violent Crime Rate	Regression	753910.557	8	94238.820	26.723	.000[b]
	Residual	35265.623	10	3526.562		
	Total	789176.179	18			
Property Crime Rate	Regression	4507155.808	8	563394.476	17.976	.000[c]
	Residual	313416.151	10	31341.615		
	Total	4820571.958	18			

a. Predictors: (Constant), national total crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population
b. Predictors: (Constant), national violent crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population
c. Predictors: (Constant), national property crime rate, unemployment rate, population, project dummy, median household income, poverty level, median age of population

Table 5 displays the analysis of variance (ANOVA) results. The calculated F can be observed from table 5 and compared to the critical value of F to decide whether to accept the null hypothesis or the alternative hypothesis. Critical F at a 0.05 significance level with 7 degrees of freedom at the numerator and 11 degrees of freedom at the denominator is 3.01. Comparing the calculated F of 23.430 for total crime rate, 27.945 for violent crime rate, and 15.511 for property crime rate means the alternative hypothesis must be accepted and the independent variables in the multiple regression have a significant influence on the dependent variable. In order to confirm which regression coefficients might be zero and which might not be, an assessment of each of the coefficients must be conducted under the constraints that the null hypothesis states each coefficient (β) is equal to zero, and the alternative hypothesis states that each coefficient (β) is different from zero (Kulcsar, 2009). The test utilized was a *t*-test to determine whether to accept or reject the null hypothesis.

Table 6a - Bivariate Regression	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	β	t	Sig
(Constant)	5636.393	129.996		43.358	<.001
Project Dummy	-1265.870	193.787	-0.839	-6532	<.001

Dependent Variable: Total Crime Rate

Table 6b - Bivariate Regression	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	β	t	Sig
(Constant)	1401.327	31.355		44.693	<.001
Project Dummy	-367.846	46.741	-0.880	-7.870	<.001

Dependent Variable: Violent Crime Rate

Table 6c - Bivariate Regression	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	β	t	Sig
(Constant)	4235.073	104.388		40.571	<.001
Project Dummy	-898.038	155.612	-0.806	-5.771	<.001

Dependent Variable: Property Crime Rate

Results

A t-test with n-(k+1) degrees of freedom (where n = total number of cases and k = number of different groups to which the sampled cases are sorted) for each of the eight variables will complete an individual evaluation of the regression coefficients. Each of the calculated t values from Table 2 compared with the critical t value will indicate which regression coefficients are zero and which are not. Critical t at a 0.05 significance level with 20-(8+1) indicating 11 degrees of freedom is ±1.796. The results are as follows; for the dependent variable "total crime rate" educational attainment had a calculated t value (-2.507) lower than critical t (-1.796) and a significance level (0.031) lower than the chosen significance level of 0.05, indicating the null hypothesis should be rejected and β_3 is not equal to zero. Additionally, homeownership rate had a calculated t value (2.367) higher than critical t (1.796) and a significance level (0.040) lower than the chosen significance (0.05) indicating the null hypothesis should be rejected and β_4 is different from zero. Unemployment rate also had a calculated t value (-3.692) lower than critical t (-1.796) and a significance level (0.004) lower than the chosen significance (0.05) indicating again that the null hypothesis should be rejected and β_5 is not equal to zero. Lastly for the

dependent variable "total crime rate," poverty rate had a calculated t value (2.786) higher than critical t (1.796) and a significance level (0.019) lower than the chosen significance (0.05) indicating β_6 is not equal to zero and the null hypothesis should be rejected.

For the dependent variable "violent crime rate" homeownership rate had a calculated t value (2.235) is higher than critical t (1.796) and the significance level (0.049) is lower than the chosen significance level (0.05) so the null hypothesis should be rejected and β_4 is not equal to zero. Unemployment rate has a calculated t value (-2.880) higher than critical t (1.796) and a significance level (0.016) lower than the chosen significance level (0.05) therefore the null hypothesis should be rejected, and it is accepted that β_5 is not equal to zero. Finally, poverty rate had a calculated t value (2.665) higher than critical t (1.796) and a significance (0.024) lower than the chosen significance (0.05) indicating that the null hypothesis should be rejected and β_6 is not equal to zero. Finally, for the dependent variable "property crime rate," educational attainment had a lower calculated t value (-2.485) than critical t (1.796) and a lower significance (0.032) than the chosen significance (0.05) indicating that β_3 is not equal to zero and the null hypothesis should be rejected. Additionally, unemployment rate had a lower calculated t value (-3.256) than critical t (1.796) indicating the null hypothesis should be rejected and $\beta5$ is not equal to zero. From this data, the conclusion can be drawn that although the chosen blight abatement CPTED was included in the predictive variables in the multivariate regression, this study shows the project did not have a significant impact on the total, violent, or property crime rates in Philadelphia from 2000-2019.

Discussion

Overall, the CPTED project was not shown to be significant in reducing crime rates in Philadelphia. After completing the regression and studying all the variables, the most significant

variables on the crime rate in Philadelphia were shown to be educational attainment, homeownership rate, unemployment rate, and poverty rate. Educational attainment was measured in this study as the percent of persons over the age of 25 that have achieved at least a bachelor's degree and was shown to have a significant negative correlation to total, violent and property crime in this regression. Studies in the past have indicated that more schooling significantly reduces the likelihood that a person will commit criminal acts (Lochner & Moretti, 2004). Additional research by the Justice Policy Institute examined ten states with the highest and lowest college enrollment rates and found that on average, states with higher college enrollment rates had lower violent crime rates than states with the lowest college enrollment rates (Page, Petteruti, Walsh, & Ziedenburg, 2007). The negative correlation indicates that an increase in educational attainment saw a decrease in total, violent, and property crimes in Philadelphia for the measured years, confirming prior findings that indicate a similar correlation.

Additionally, homeownership rate was measured to have a significant positive relationship with total and violent crime in this regression. This finding contradicts some prior research (Raleigh & Galster, 2014). Possible reasons for this contradiction could include states being unable to recover well from the housing market crash in 2008. Additionally, while previous research establishes correlations between high homeownership rates and low crime rates, no research has confirmed if high homeownership rates cause an area's crime rate to lower or if already-low crime rates simply attract homeowners more. Unemployment rate had a significant negative relationship with total, violent, and property crimes. This contradicts some points in prior research. One study found a positive relationship between property crimes and unemployment rates but found a strong negative correlation between the same. Raphael and Winter-Ebmer attribute this puzzling and seemingly counterintuitive correlation to an

unaccounted for "violence-creating factor that varies systematically with unemployment rates" (Raphael & Winter-Ebmer, 2001). This correlation could be due to exposure time and length variations between those who are employed and those who are unemployed (i.e., someone with employment could be out in public and therefore exposed to more offenders than someone without employment). This idea overlaps broadly with Routine Activity Theory. Routine Activity Theory was proposed in 1979 by Cohen and Felson in "Social Change and Crime Rate Trends: A Routine Activity Approach." The theory posits that three elements are essential for a crime to be committed: a motivated offender, a suitable target, and the absence of capable guardianship. The most important factor being that there must be opportunity available for an offender to commit a crime. It is this opportunity that is created when someone has a commute to work and regularly has outings in public, these increased outings provide more opportunities for a crime to happen than would be available for someone not employed and regularly having a commute.

Poverty rate in this study was measured as the percent of persons living below the Federal Poverty Line (FPL). The study shows a significant positive relationship which confirms past research findings; an increase in people living below the FPL brings an increase in crime. The Bureau of Justice Statistics found from 2008 to 2012 that persons at or below the FPL had more than double the rate of violent victimizations than persons in higher income households and had higher rates of firearm violence (Harrell, Langton, Berzofsky, Couzens, & Smiley-McDonald, 2014). The results from the current study have similar correlations: and increase in persons at or below the FPL is correlated with a higher rate of crime. All these correlations confirmed by the regression in this study and the insights received from this data and research will contribute to the quantitative data already in existence regarding CPTED projects affecting

the crime rates in Philadelphia (Branas, et al., 2016; Loesch, 2018; Branas, et al., 2018; Garvin, Branas, Keddem, Sellman, & Cannuscio, 2012). This study accounted for most of the variance through the chosen predictors, but there is the possibility of unmeasured variables that could have affected and confounded the variables in this study.

It should be noted that the research could possibly obtain a more accurate and reliable measure if year-by-year acreage or lot counts for land obtained by the Landcare Program were available to add as an additional control variable. Seeing if there is a higher correlation between the program and crime rates could be studied if exact amounts of land under the program's care could be obtained. While the Landcare Program's website lists total acreage and parcels of land obtained to date, but no information on the year of acquisition is listed in the data. The City of Philadelphia website contains some publicly released datasets that contain a 2015 and a 2017 report of vacant parcels that were acquired and given the "Clean and Green" treatment by PHS during the respective years of the data set release. No other years have publicly released data that was able to be located through the internet. In an attempt to complete the due diligence for this research and acquire the acreage or lot counts for more thorough research, contact was made through the Landcare Program's email listed as contact on the website. Additionally, contact was made via email with the former Director, current Director, Associate Director of Urban Activation, Chief Development Officer, and Director of Urban Design. No counts or accurate acreage year-by-year were able to be obtained from any contacts made. Additionally, phone calls were made to the PHS phone number listed on the website attempting to acquire year-by-year data. After multiple weeks in contact with the PHS, no substantial year-by-year information going back to 2000 was able to be obtained.

Limitations and Future Research Suggestions

Although this study found no significant correlation between the CPTED project and the crime rate in Philadelphia, this study is limited in terms of generalizability. Only one, relatively larger sized city was examined, and there could be much different results if cities of differing sizes were compared. Additionally, an additive effect for more than one CPTED project within an area could provide insight if there are multiple types of projects that can produce a higher variation of the desired output (lower crime). This study was also a city-wide study and therefore, research looking into smaller sections within cities or neighborhoods would be able to take a more in-depth look at crime in specific areas. Further, the control variables chosen are not the only potential predicters of crime and benefit could be found from choosing different control variables to control with. Finally, this study only examined a city in the U.S., studies examining cities in other countries would produce different results as the U.S. is somewhat unique in its crime variants and frequency. This research could be more substantial if lot counts, or acreage could be obtained and used as a control variable. Measuring if there is an increasing reduction in any crimes as land is obtained and cared for by the program could provide more insight into the relationship between the program and crime rates.

This study does not overlook the benefit many neighborhoods have in "greening" or upkeep of abandoned properties in their area. Numerous studies have shown reduced violent crime (Loesch, 2018), gun violence (Branas, et al., 2016), and an increase in resident's commitment and involvement in their community (Walker & Engh, 2017). While the results do not show significant correlation between this CPTED project and crime rates, these types of projects are not without value. While costly, CPTED is an emerging solution to crime for many areas. Future research that looks more in-depth into neighborhoods that practice CPTED would

be of great value. This study is not intended at this time to be a generalizable method for other cities but to raise questions about the more long-term effects of CPTED projects.

Conclusion

Studies have posited that nearly 15 percent of all land in U.S. cities is vacant or abandoned (Branas, et al., 2018). These properties are often the target of CPTED projects in an effort to reduce crime in the neighborhood around that land, and in the city in general. While these projects are often beneficial to the neighborhoods near the properties, on a large scale, the projects often do not make major changes to the crime rates in larger cities. Looking into the benefits of CPTED projects requires an in-depth, multi-viewpoint approach that can often be overlooked when looking large-scale at full cities. As more and more of the world becomes urbanized, cities feel compelled to answer the call to provide safer cities for their residents, and CPTED has provided the framework to allow safety to be at the forefront of city planning projects.

This study attempted to find a correlation between a blight abatement CPTED project and the total, violent, and property crime rates in Philadelphia between 2000 and 2019 while controlling for other variables that could be predictors for the crime rate. There was not enough evidence to reject the null hypothesis and no significant correlation could be found for the data utilized in this study. While this study did not find any correlation between the crime rate in Philadelphia and their blight abatement program over time, prior research has shown reduced firearm violence (Branas, et al. 2016) and increased mental and physical health for residents in Philadelphia (Loesch, 2018). This study will ideally be part of further research including other variables, with an overall goal of providing evidence of the correlation between CPTED projects and a reduction in crime.

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Type of document: ['Thesis']

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Keywords (3-5 keywords not included in the title that uniquely describe content): Blight Abatement, Crime Research, Remediation, Crime Prevention Through Environmental Design, Urban Areas

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