University of Cincinnati

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I, Joshua K Murphy , hereby submit this original work as part of the requirements for the degree of Master of Arts in Geography.

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Examining the Distribution of Robberies in Cincinnati:
The residual effects of an aggressive policing policy

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EXAMINING THE DISTRIBUTION OF ROBBERIES IN CINCINNATI: THE RESIDUAL EFFECTS OF AN AGGRESSIVE POLICING POLICY

A Thesis Submitted to

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McMicken College of Arts & Sciences

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By

Joshua K. Murphy

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EXAMINING THE DISTRIBUTION OF ROBBERIES IN CINCINNATI: THE RESIDUAL EFFECTS OF AN AGGRESSIVE POLICING POLICY

by

Joshua Keith Murphy, MA

The University of Cincinnati, 2012

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Abstract:

The intrinsic value, or outcome, of aggressive policing units and their overall effect on crime itself is a highly contentious topic, not only within the community, but also within criminology theories and policing policy debates. Whether these zero tolerance patrol units, through their high number of arrests for minor offenses, actually combat crime and bring with them a diffusion of benefits, or if these units merely displace crime into areas outside the intended target area, is an issue in which no scholarly consensus has yet to be reached. Increasing evidence suggests that the diffusion of benefits is not likely to occur (Barr and Pease 1990, Bowers and Johnson 2003, Brantingham and Brantingham 2003, Eck 1993, Hessling 1994); however, a study in 2009 suggests that evidence of a diffusion of benefits has been found in Cincinnati, Ohio (Hall and Liu 2009). This research examines the occurrence of robberies in the City of Cincinnati from 2006-2009 and assesses the impact of an aggressive policing policy known as “Operation Vortex.”

University of Cincinnati Geography Department

Examining the Distribution of Robberies in Cincinnati:

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By: Joshua K Murphy

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Introduction

This research examines the occurrence of robberies in the City of Cincinnati from 2006-2009 and assesses the impact of an aggressive policing policy known as “Operation Vortex.” The purpose of this study is to investigate if the residual effects of this policy can be linked to a diffusion of benefits or to an overall displacement of robberies in Cincinnati. This investigation is accomplished by examining the change in the overall number of robberies, per 1km network distance buffer, and their distance from the target of Operation Vortex, the Cincinnati neighborhood of Over-the-Rhine (OTR).

Background

Over-the-Rhine's distinctive name comes from its early residents, German immigrants from the mid-19th century (OTR Foundation). At that time, a canal separated this residential area of German settlement from downtown Cincinnati, and this canal was nicknamed "the Rhine" in reference to the Rhine River in Germany as a reminiscence of these settlers’ European homeland. Over time this colloquialism became popular and easily entered the local lexicon, and the neighborhood north of “the Rhine” canal became known as Over-the-Rhine (OTR Foundation). The canal itself is long gone, and is now a six-lane thoroughfare known as Central Parkway; nevertheless, the parkway today serves as an equally distinctive and visible boundary separating Over-the-Rhine from Cincinnati’s downtown neighborhood, officially known as CBD/Riverfront.

Throughout its long history, the neighborhood of Over-the-Rhine has undergone numerous and stark changes in terms of demographics, economics and urban function. In tandem with its southern neighbor of CBD/Riverfront, Over-the-Rhine has experience wide transition,

loss of business and population, gentrification and reinvigoration over the past 150 years. Unlike CBD/Riverfront, however, Over-the-Rhine has also, in its recent mid-20th century history, undergone more severe tumultuous times, as it has transformed into an area of constant and varied crime .Over-the-Rhine area has long carried a social and cognitive geographic stigma as a violent, dangerous area, to the point of being identified, erroneously, as statistically the most dangerous neighborhood in the United States (WLWT 2009). Over-the-Rhine today is a contrast of pockets of distinctive building and business reinvigoration, juxtaposed in some cases by merely a city or block, or even within the same city block of vacant and condemned building stock. In addition, today some areas of the neighborhood are uniformly comprised of dilapidated buildings, some of which are in fact occupied by businesses and residents, but many of which are abandoned and neglected, and have been so for years..

The U.S. Census Bureau reports that part of Over-the-Rhine currently has one of the highest rates of abandoned and vacant properties in the country (Cincinnati Enquirer 2010). As of 2009, many of the buildings in Over-the-Rhine are vacant allowing squatters, vagrants, prostitutes, drug addicts and dealers to occupy them illegally (OTR Foundation).

To combat these high levels of vagrancy and crime within OTR the Cincinnati Police Department (CPD) authorized the use of an aggressive policing endeavor in the summer of 2006. This highly publicized policing policy, known as “Operation Vortex”, consisted of “an élite sixty-man crime-fighting squad code-named Vortex” (Seabrook 2009), CPD patrol units, and Hamilton County Sheriff deputies. These “Vortex” units conducted zero-tolerance sweeps of high-crime areas in OTR, arresting people for misdemeanors that included jaywalking, loitering, possession of an open container, and possession of drug paraphernalia, as well as for more serious crimes, all in an attempt to reduce crime through increasing police presence (Hall and Liu

2009). In the first 25 days these units made over 1000 arrests, and by the end of September of 2006 a staggering 2600 had been made (Seabrook 2009).

Early on, the Cincinnati Police Department boasted the success of Operation Vortex through self-reporting of the numbers of increased arrests and consequent lowered crime rates. However, as time went on, the calls to the CPD for service in the neighborhoods surrounding Over-the-Rhine began increasing (Wagner 2006), suggesting that rather than preventing crime, CPD and Operation Vortex had merely moved it "around the corner (Eck 2004)."

Literature Review

The intrinsic value, or outcome, of aggressive policing units and their overall effect on crime itself is a highly contentious topic, not only within the community, but also within criminology theories and policing policy debates. Whether these zero tolerance patrol units, through their high number of arrests for minor offenses, actually combat crime and bring with them a diffusion of benefits, or if these units merely displace crime into areas outside the intended target area, is an issue in which no scholarly consensus has yet to be reached.

A diffusion of benefits occurs when "reductions of crime, or other improvements, are achieved in areas that are close to crime-prevention interventions, even though those areas were not actually targeted by the intervention itself" (Clarke and Weisburd 1994). Increasing evidence suggests that the diffusion of benefits is not likely to occur (Barr and Pease 1990, Bowers and Johnson 2003, Brantingham and Brantingham 2003, Eck 1993, Hessling 1994); however, a study in 2009 suggests that irrefutable evidence of a diffusion of benefits has been found in Cincinnati, Ohio (Hall and Liu 2009).

Crime displacement is the opposite of a diffusion of benefits, and is defined as the relocation of a crime from one place, time, target, offense, tactic, or offender to another as a result of some crime-prevention initiative (Bowers and Guerette 2009). Though by far, spatial displacement (place) is the form of crime displacement that is most commonly recognized (Eck 1993), and is the one focused on for this study. Though displacement is most often viewed as a negative impact of aggressive policing, even when the displacement of crime does occur, it can still provide positive benefits in some instances: for example, the amount of crime displaced could be less; the types of crime can be changed to a less serious type, or "the relocation of crime to a less vulnerable group of the population" (Clarke & Weisburd 1994) can occur.

A crucial component for assessing the displacement of crime is to understand how far an offender is willing to travel from his/her residence, place of employment, or place of recreation to the locations where they commit an offence. Literature on the topic of criminal behavior dates back to the early 1800s (Guerry 1832, Quetelet 1842). One very influential paper on the topic states that "Criminals travel certain distances from their residence, place of employment, or place of recreation to the offense locations" (Lu 2003). This journey, from whatever origin, to the area in which the crime is perpetrated is coined by Lu as the "Journey-to-Crime" (Lu 2003).

Contemporary literature, like that of Lu, focuses on the fact that very few studies have examined the distance component of crime (Lu 2003). One of the major findings by Kent, Leitner, and Curtis is that traditional methods of modeling have avoided the use of functional distance measures when modeling an offender's journey-to-crime within a multifarious metropolitan landscape (Kent, Leitner, and Curtis 2006). By replacing typical Euclidean distances with a function that takes into account a more realistic way of traveling in downtown areas of larger US cities along their common rectangular street pattern, these authors found that

the predicted movement of criminals though an assorted landscape, with many cultural and geographical boundaries, can help to increase both the utility and accuracy of these crime models (Kent, Leitner, and Curtis 2006).

Over the years a series of studies have been conducted to examine the individual differences in distances travelled by criminals (Baldwin and Bottoms 1976, Snook 2003, Levine and Lee 2009, Lu 2003). The most consistent of these findings are that a criminal's travel to crime is local in nature and that certain areas, like the central business district, work and recreation places, and the poorest areas in the city, have important effects on the orientation of "journey-to-crime" (Lu 2003). Snook's study of serial criminals in St. John's, Newfoundland, Canada found that on average criminals traveled 1.7 kilometers (1.05miles) from their homes to commit an offense. Figure 1 from his study, replicated below, shows that there are many more short distances traveled in comparison to long ones, with the majority of targets being selected between 1 and 2 kilometers.

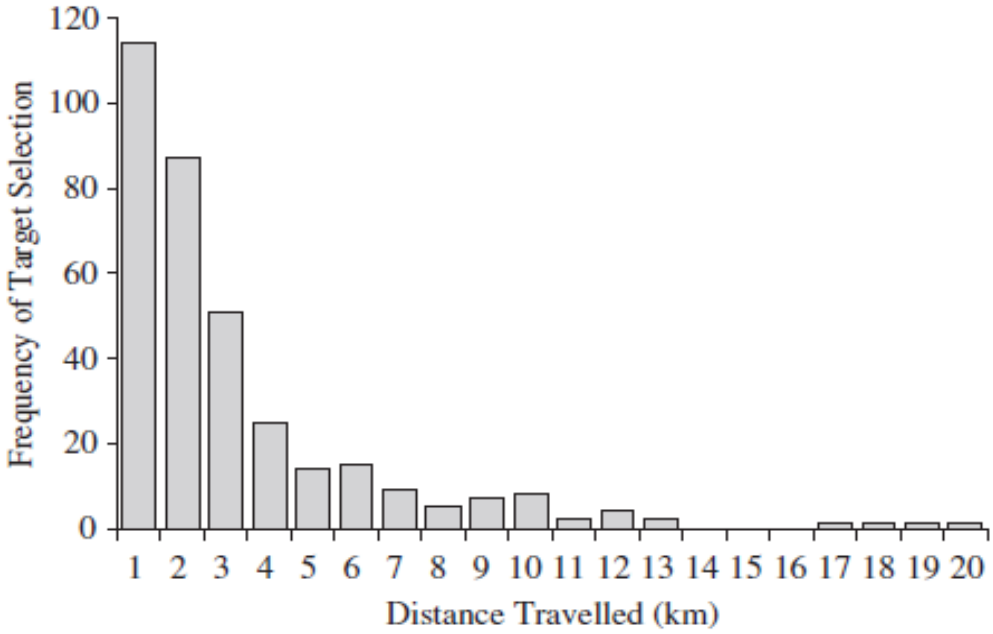


Figure 1. Relationship between the distance travelled and frequency of target selection.

Researchers of crime displacement often overlay their study areas with buffer zones in order to analyze the presence of the displacement of crime from the intended target area. Establishing an adequate buffer size for measuring the displacement of crime/diffusion of benefits is an important issue to criminology studies and is a multifaceted task, given the intricacy and complexity of understanding geographic scale, and the predominance in geographic theory corroborating the occurrences of Tobler's First Law of Geography and distance decay function. In 2003, Bowers and Johnson presented the Weighted Displacement Quotient (WDQ), a new spatial technique that they had developed as a means of measuring both crime displacement and the diffusion of benefits that resulted from aggressive policing policies. These authors describe the concept theoretically as identifying the landscape as isotropic areas A, B, and C, which are nested within each other (Figure 1) Area A is the target area in which the crime prevention operation takes place. Immediately surrounding the target area is Area B, a buffer area that has potentially been influenced by the crime prevention operation implemented in Area

A; thus, Area B represents the theoretical displacement zone of crime reduction that has occurred in Area A. It must be noted, however, that Area B does not include Area A, but rather is the concentric zone encircling it. Beyond the boundary of area B is Area C, a wider control area that does not include areas A or B, and is theoretically unlikely to be influenced by changes within either Areas A or B (Bowers and Johnson 2003).

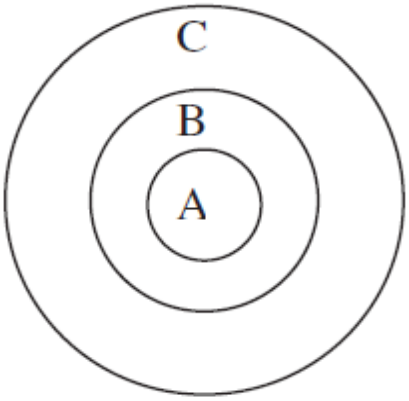


Fig. 1. Three nested areas.

The manner in which the weighted displacement quotient (WDQ) is able to empirically detect either a displacement of crime or its diffusion of benefits is by investigating the changes in the crime rate expressed in each buffer zone, using the following equation:

Equation 1. $$WDQ_{Area\_A} \frac{\left(\frac{B_1}{C_1}\right) - \left(\frac{B_0}{C_0}\right)}{\left(\frac{A_1}{C_1}\right) - \left(\frac{A_0}{C_0}\right)}$$

The possible values of this equation range from -1 to 1; a WDQ score of 0 indicates that the employment of a new crime enforcement tactic or prevention program does not lead to crime displacement or a diffusion of benefits. Negative WDQ scores suggest displacement of crime,

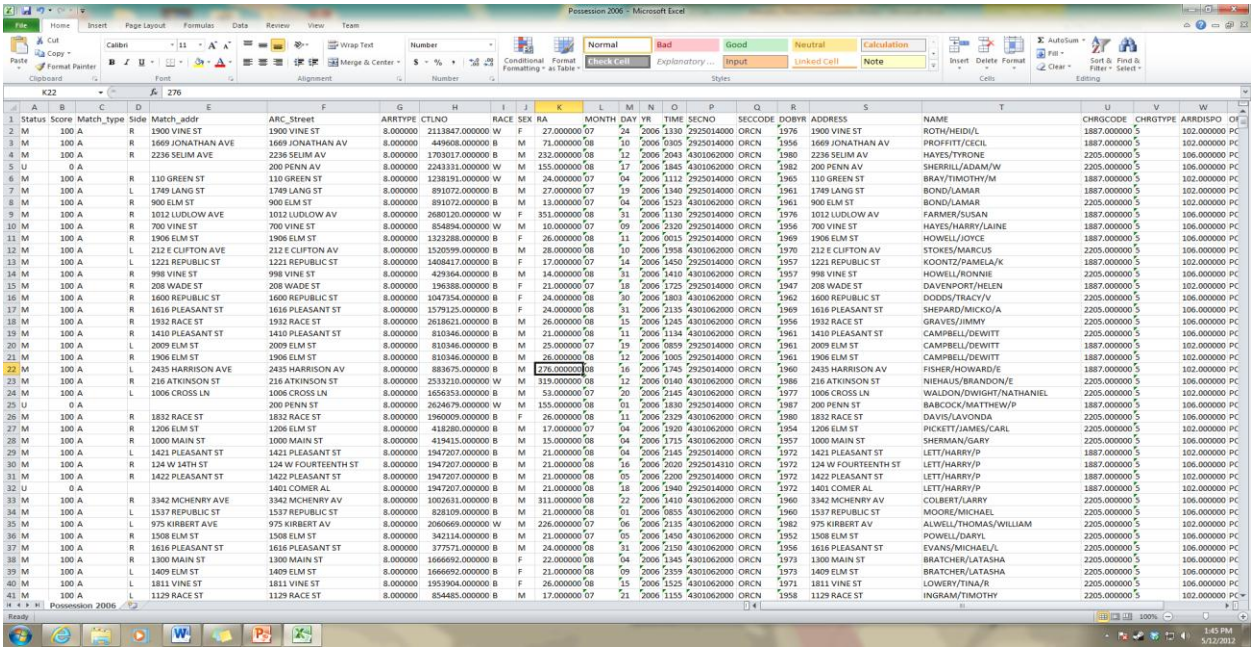
while positive scores indicate a diffusion of benefits. Thus, a WDQ score of 0.5 indicates that a diffusion of benefits is equal to half of the direct effects of the crime prevention treatment. A result of -1 indicates that all direct effects of the crime prevention treatment are displaced to the buffer area (Bowers & Johnson 2003).

Data

The data employed in this research in order to study the spatial distribution of robberies in Cincinnati, Ohio were collected from the calls for service made to all local Cincinnati Police Departments (CPD), and consisted of crime and arrestee data from 2006-2009. From this universe, this study uses two subset of that data: (1) robberies and aggravated robberies (with no differentiation between the two), and (2) arrests of possession of an open flask and possession of drug paraphernalia. These data were obtained for each year from 2003 through 2009, inclusive, and each year of data was geocoded using the Cincinnati Area Geographic Information Systems (CAGIS) geo-locator, a program developed by local GIS professionals. The geocoding process resulted in 90-97% of points being matched; unmatched points were removed.

The calls-for-service data collected from the CPD are maintained within a database that includes the location, date, time of day, complaint code/description, unit response time, and priority code for each call, listed below in figure 1.

Figure 1. View of CPD Calls for Service Data



Status	Score	Match_type	Side	Match_addr	ARC_Street	ARRTYPE	CTLNO	RACE	SEX	RA	MONTH	DAY	YR	TIME	SECNO	SECCODE	DOBYR	ADDRESS	NAME	CHRGCODE	CHRGTYPE	ARRDISPO
M	100	A	R	1900 VINE ST	1900 VINE ST	8.000000	2113847.000000	W	F	27.000000	07	24	2006	1330	2925014000	ORCN	1976	1900 VINE ST	ROTH/HEIDI/L	1887.000000	5	102.000000
M	100	A	R	1669 JONATHAN AVE	1669 JONATHAN AV	8.000000	449608.000000	B	M	71.000000	08	10	2006	0305	2925014000	ORCN	1956	1669 JONATHAN AV	PROFFITT/CECIL	1887.000000	5	102.000000
M	100	A	R	2236 SELIM AVE	2236 SELIM AV	8.000000	1703017.000000	B	M	232.000000	08	12	2006	2043	4301062000	ORCN	1980	2236 SELIM AV	HAYES/TYRONE	2205.000000	5	106.000000
U	0	A			200 PENN AV	8.000000	2243331.000000	W	M	155.000000	08	17	2006	1845	4301062000	ORCN	1982	200 PENN AV	SHERRILL/ADAM/W	2205.000000	5	106.000000
M	100	A	R	110 GREEN ST	110 GREEN ST	8.000000	1238191.000000	W	M	24.000000	07	04	2006	1112	2925014000	ORCN	1965	110 GREEN ST	BRAY/TIMOTHY/M	1887.000000	5	102.000000
M	100	A	L	1749 LANG ST	1749 LANG ST	8.000000	891072.000000	B	M	27.000000	07	19	2006	1340	2925014000	ORCN	1961	1749 LANG ST	BOND/LAMAR	1887.000000	5	102.000000
M	100	A	R	900 ELM ST	900 ELM ST	8.000000	891072.000000	B	M	13.000000	07	04	2006	1523	4301062000	ORCN	1961	900 ELM ST	BOND/LAMAR	2205.000000	5	102.000000
M	100	A	R	1012 LUDLOW AVE	1012 LUDLOW AV	8.000000	2680120.000000	W	F	351.000000	08	31	2006	1130	2925014000	ORCN	1976	1012 LUDLOW AV	FARMER/SUSAN	1887.000000	5	106.000000
M	100	A	R	700 VINE ST	700 VINE ST	8.000000	854894.000000	W	M	10.000000	07	09	2006	2320	2925014000	ORCN	1956	700 VINE ST	HAYES/HARRY/LAINE	1887.000000	5	106.000000
M	100	A	R	1906 ELM ST	1906 ELM ST	8.000000	1323288.000000	B	F	26.000000	08	11	2006	0015	2925014000	ORCN	1969	1906 ELM ST	HOWELL/JOYCE	1887.000000	5	106.000000
M	100	A	L	212 E CLIFTON AVE	212 E CLIFTON AV	8.000000	1520599.000000	B	M	28.000000	08	10	2006	1958	4301062000	ORCN	1970	212 E CLIFTON AV	STOKES/MARCUS	2205.000000	5	106.000000
M	100	A	L	1221 REPUBLIC ST	1221 REPUBLIC ST	8.000000	1408417.000000	B	F	17.000000	07	14	2006	1450	2925014000	ORCN	1957	1221 REPUBLIC ST	KOONTZ/PAMELA/K	1887.000000	5	102.000000
M	100	A	R	998 VINE ST	998 VINE ST	8.000000	429364.000000	B	M	14.000000	08	31	2006	1410	4301062000	ORCN	1957	998 VINE ST	HOWELL/RONNIE	2205.000000	5	106.000000
M	100	A	R	208 WADE ST	208 WADE ST	8.000000	196388.000000	B	F	21.000000	07	18	2006	1725	2925014000	ORCN	1947	208 WADE ST	DAVENPORT/HELEN	1887.000000	5	102.000000
M	100	A	R	1600 REPUBLIC ST	1600 REPUBLIC ST	8.000000	1047354.000000	B	F	24.000000	08	30	2006	1803	4301062000	ORCN	1962	1600 REPUBLIC ST	DODDS/TRACY/V	2205.000000	5	106.000000
M	100	A	R	1616 PLEASANT ST	1616 PLEASANT ST	8.000000	1579125.000000	B	F	24.000000	08	31	2006	2135	4301062000	ORCN	1969	1616 PLEASANT ST	SHEPARD/MICKO/A	2205.000000	5	106.000000
M	100	A	R	1932 RACE ST	1932 RACE ST	8.000000	2618621.000000	B	M	26.000000	08	15	2006	1245	4301062000	ORCN	1956	1932 RACE ST	GRAVES/JIMMY	2205.000000	5	106.000000
M	100	A	R	1410 PLEASANT ST	1410 PLEASANT ST	8.000000	810346.000000	B	M	21.000000	08	11	2006	1134	4301062000	ORCN	1961	1410 PLEASANT ST	CAMPBELL/DEWITT	2205.000000	5	106.000000
M	100	A	L	2009 ELM ST	2009 ELM ST	8.000000	810346.000000	B	M	25.000000	07	19	2006	0859	2925014000	ORCN	1961	2009 ELM ST	CAMPBELL/DEWITT	1887.000000	5	102.000000
M	100	A	R	1906 ELM ST	1906 ELM ST	8.000000	810346.000000	B	M	26.000000	08	12	2006	1005	2925014000	ORCN	1961	1906 ELM ST	CAMPBELL/DEWITT	1887.000000	5	102.000000
M	100	A	L	2435 HARRISON AVE	2435 HARRISON AV	8.000000	883675.000000	B	M	276.000000	08	16	2006	1745	2925014000	ORCN	1960	2435 HARRISON AV	FISHER/HOWARD/E	1887.000000	5	102.000000
M	100	A	R	216 ATKINSON ST	216 ATKINSON ST	8.000000	2533210.000000	W	M	319.000000	08	12	2006	0140	4301062000	ORCN	1986	216 ATKINSON ST	NIEHAUS/BRANDON/E	2205.000000	5	106.000000
M	100	A	L	1006 CROSS LN	1006 CROSS LN	8.000000	1656353.000000	B	M	53.000000	07	20	2006	2145	4301062000	ORCN	1977	1006 CROSS LN	WALDON/DWIGHT/NATHANIEL	2205.000000	5	102.000000
U	0	A			200 PENN ST	8.000000	2624679.000000	W	M	155.000000	08	01	2006	1830	2925014000	ORCN	1987	200 PENN ST	BABCOCK/MATTHEW/P	1887.000000	5	106.000000
M	100	A	R	1832 RACE ST	1832 RACE ST	8.000000	1960009.000000	B	F	26.000000	08	11	2006	2329	4301062000	ORCN	1980	1832 RACE ST	DAVIS/LAVONDA	2205.000000	5	106.000000
M	100	A	R	1206 ELM ST	1206 ELM ST	8.000000	418280.000000	B	M	17.000000	07	04	2006	1920	4301062000	ORCN	1954	1206 ELM ST	PICKETT/JAMES/CARL	2205.000000	5	102.000000
M	100	A	R	1000 MAIN ST	1000 MAIN ST	8.000000	419415.000000	B	M	15.000000	08	04	2006	1715	4301062000	ORCN	1957	1000 MAIN ST	SHERMAN/GARY	2205.000000	5	106.000000
M	100	A	L	1421 PLEASANT ST	1421 PLEASANT ST	8.000000	1947207.000000	B	M	21.000000	08	04	2006	2145	2925014000	ORCN	1972	1421 PLEASANT ST	LETT/HARRY/P	1887.000000	5	102.000000
M	100	A	R	124 W 14TH ST	124 W FOURTEENTH ST	8.000000	1947207.000000	B	M	21.000000	08	16	2006	2020	2925014310	ORCN	1972	124 W FOURTEENTH ST	LETT/HARRY/P	1887.000000	5	106.000000
M	100	A	R	1422 PLEASANT ST	1422 PLEASANT ST	8.000000	1947207.000000	B	M	21.000000	08	05	2006	2200	2925014000	ORCN	1972	1422 PLEASANT ST	LETT/HARRY/P	1887.000000	5	102.000000
U	0	A			1401 COMER AL	8.000000	1947207.000000	B	M	21.000000	08	18	2006	1940	2925014000	ORCN	1972	1401 COMER AL	LETT/HARRY/P	1887.000000	5	102.000000
M	100	A	R	3342 MCHENRY AVE	3342 MCHENRY AV	8.000000	1002631.000000	B	M	311.000000	08	22	2006	1410	4301062000	ORCN	1960	3342 MCHENRY AV	COLBERT/LARRY	2205.000000	5	106.000000
M	100	A	L	1537 REPUBLIC ST	1537 REPUBLIC ST	8.000000	828109.000000	B	M	21.000000	08	01	2006	0855	4301062000	ORCN	1960	1537 REPUBLIC ST	MOORE/MICHAEL	2205.000000	5	106.000000
M	100	A	L	975 KIRBERT AVE	975 KIRBERT AV	8.000000	2060669.000000	W	M	226.000000	07	06	2006	2135	4301062000	ORCN	1982	975 KIRBERT AV	ALWELL/THOMAS/WILLIAM	2205.000000	5	102.000000
M	100	A	R	1508 ELM ST	1508 ELM ST	8.000000	342114.000000	B	M	21.000000	07	05	2006	1450	4301062000	ORCN	1952	1508 ELM ST	POWELL/DARYL	2205.000000	5	106.000000
M	100	A	R	1616 PLEASANT ST	1616 PLEASANT ST	8.000000	377571.000000	B	M	24.000000	08	31	2006	2150	4301062000	ORCN	1956	1616 PLEASANT ST	EVANS/MICHAEL/L	2205.000000	5	106.000000
M	100	A	R	1300 MAIN ST	1300 MAIN ST	8.000000	1666692.000000	B	F	22.000000	08	04	2006	1345	4301062000	ORCN	1973	1300 MAIN ST	BRATCHER/LATASHA	2205.000000	5	106.000000
M	100	A	L	1409 ELM ST	1409 ELM ST	8.000000	1666692.000000	B	F	21.000000	08	09	2006	2359	4301062000	ORCN	1973	1409 ELM ST	BRATCHER/LATASHA	2205.000000	5	106.000000
M	100	A	L	1811 VINE ST	1811 VINE ST	8.000000	1953904.000000	B	F	26.000000	08	15	2006	1525	4301062000	ORCN	1971	1811 VINE ST	LOWERY/TINA/R	2205.000000	5	106.000000
M	100	A	L	1129 RACE ST	1129 RACE ST	8.000000	854485.000000	B	M	17.000000	07	21	2006	1155	4301062000	ORCN	1958	1129 RACE ST	INGRAM/TIMOTHY	2205.000000	5	102.000000

An advantage of using the CPD calls for service database is its "raw form" (Andersen 2006). These data are not official crime rate statistics that depend on the filing of a criminal charge; rather, they are a rich measurement of the numbers of robberies reported to the CPD throughout Cincinnati. Obtaining these data involved perseverance in developing relationships with local law enforcement and city officials in order to secure permission to access these records. Canter wrote explicitly about this process, and forewarns that as researchers we should not be naïve in assuming all data sets collected by police will be widely available (Canter 2009).

Methodology

The methodology used in this research is employed in order to detect either a displacement of crime or its diffusion of benefits, and is an expansion of Bowers and Johnson's (2003) Weighted Displacement Quotient (WDQ) that they had developed in order to measure

both crime displacement and a diffusion of benefits that occurred as a result of aggressive policing policies. This study employs Hall and Liu's (2009) augmentation of WDQ, in which they improved upon Bowers and Johnson's equation by adding a temporal component that enables a control area (Area A in Bowers and Johnson's scheme) to replace a tangential area (Area B) but with data from a different year. Hall and Liu named this improved method the Spatio-Temporal Weighted Displacement Quotient (STWDQ), investigates the changes in the crime rate expressed in each buffer zone, using the following equation:

Equation 2. $$STWDQ_{Area\_A} = \frac{\frac{B_{2006}}{B_{2004}} - \frac{B_{2005}}{B_{2003}}}{\frac{A_{2006}}{A_{2004}} - \frac{A_{2005}}{A_{2003}}}$$

.

Each subscript corresponds to a specific time period. An STWDQ score ranges from -1 to 1, with negative STWDQ scores suggesting displacement of crime, and positive scores indicating a diffusion of benefits. An STWDQ score of 0 suggests that the crime prevention program does not lead to displacement or diffusion of benefits, and an STWDQ score of 0.5 indicates that a diffusion of benefits is equal to half of the direct effects of the treatment. An STWDQ result of -1 indicates that the entire direct effects of the treatment are displaced to the buffer area (Hall and Liu 2009). This improvement to Bowers and Johnson's WDQ allows researchers to compare changes in crime from different time periods and to then measure crime displacement and diffusion of benefits of crime prevention initiatives at larger scales, a necessary component in understanding spatial displacement of crime that the WDQ could not address.

Hall and Liu's augmentation of a spatio-temporal component to Bowers and Johnson's WDQ was brilliant, and has advanced the understanding and analysis of geography in crime displacement theory. In their study, however, the buffer zone size that the employed was large, in some cases up to four miles in diameter, thus rendering it impossible to truly detect crime displacement due to a spatial dilution, or "washout effect" (Weisburd and Green, 1995b). Hall and Liu clearly cite Bowers and Johnson as a major contributing source for their 2009 article, though their use of a 4-mile buffer zone appears to contradict the very issue of impracticality they find in Bowers and Johnson's WDQ. "It is important to ensure that the buffer zone is not so large that any increase in crime due to displacement will be unperceivable, but large enough to ensure that any change is detectable" (Bowers and Johnson 2003)." That is, since the level of displacement may be relatively small, it may not be possible to reliably detect this small change using a very large buffer zone; the displacement that may actually be observed would simply be interpreted as "noise" in the data, if it were even detected at all. For instance, if 100 crimes were displaced into an area that suffered an average of 1000 crimes, then this would be more easily detected than if those same 100 crimes were displaced into an area that suffered 10,000 crimes for the same period of time (Bowers and Johnson 2003).

Based on research on offender mobility studies outlined in this literature review (cf. Baldwin and Bottoms 1976, Eck 1993, Snook 2003, Hall and Liu 2009, Levine and Lee 2009), this study employs a series of network distance buffers in attempting to understand crime displacement within the local context of the Over-the-Rhine neighborhood of the City of Cincinnati, and these network distance buffers have been defined using the CAGIS street network dataset and Environmental Systems Research Institute's (ESRI) Network Analyst extension.

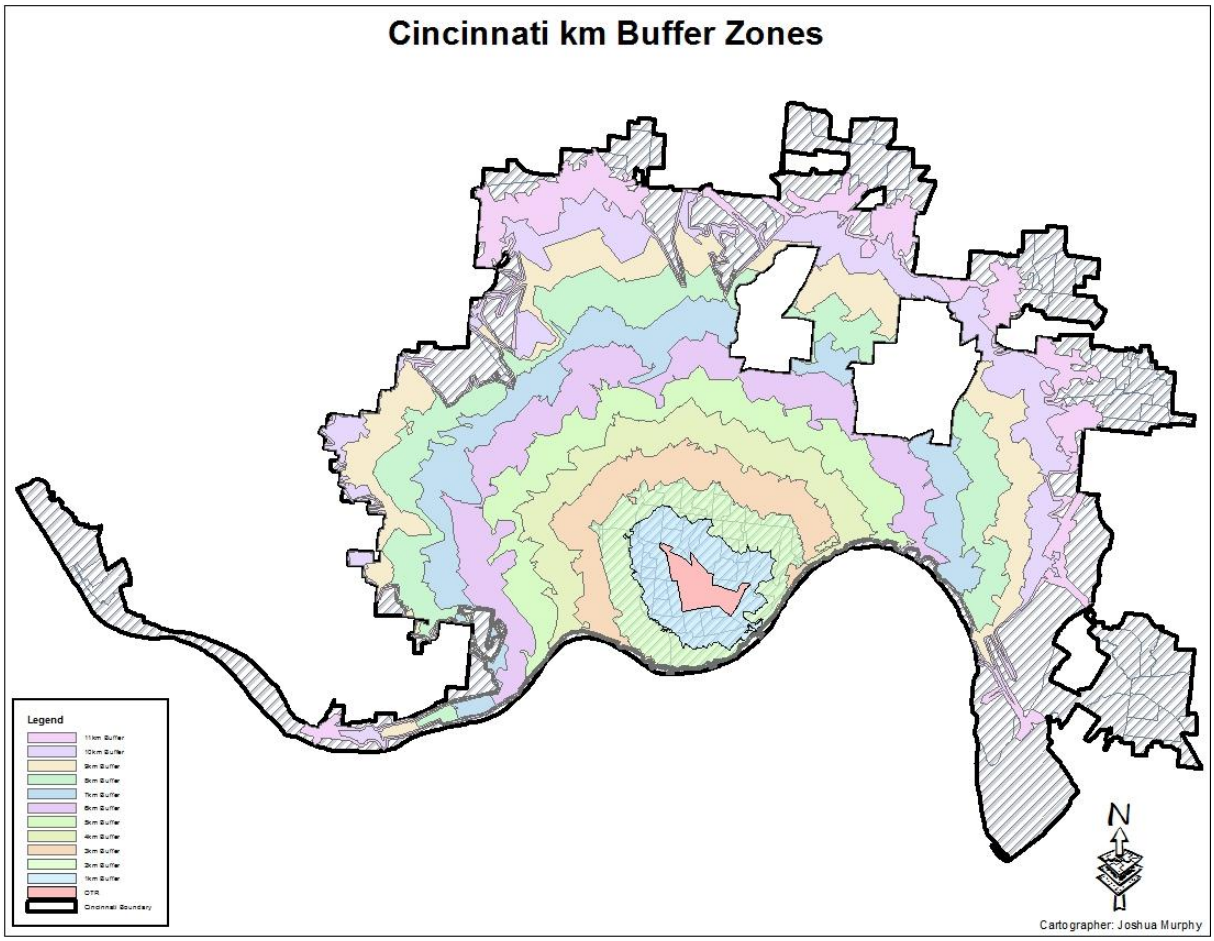


Figure 2. Buffer Zones used in Study.

These network distance buffers are created by transforming the Over-the-Rhine neighborhood polygon from the Cincinnati Statistical Neighborhood Approximations shapefile into line segments, and then converting those line segments into vertices. The result is the creation of an 11-kilometer network distance buffer zones outward from the Over-the-Rhine neighborhood for exploratory analysis, as illustrated above in figure 2.

The figure 3 below show the total number of arrests for possession of drug paraphernalia and open container from 2006 through 2009, as the distance increases from the treatment area, Over-the-Rhine. There are a tremendous number of arrests for possession and open container within the treatment area and then nearing zero throughout the rest of the city. If we compare this

with the number of robberies in each respective buffer (figure 4) there appears to be virtually no relationship between the number of arrests for these misdemeanors and the occurrence of robbery.

Table 1. Total Number of arrests for possession and open container from 2006-2009, compared to distance from OTR.

	2006	2007	2008	2009
OTR	804	340	487	129
1km	202	230	255	130
2km	52	43	110	54
3km	82	67	84	59
4km	71	66	72	40
5km	62	67	79	43
6km	63	56	76	43
7km	24	31	26	12
8km	19	21	19	18
9km	27	20	21	17
10km	12	22	17	25
11km	7	5	6	6

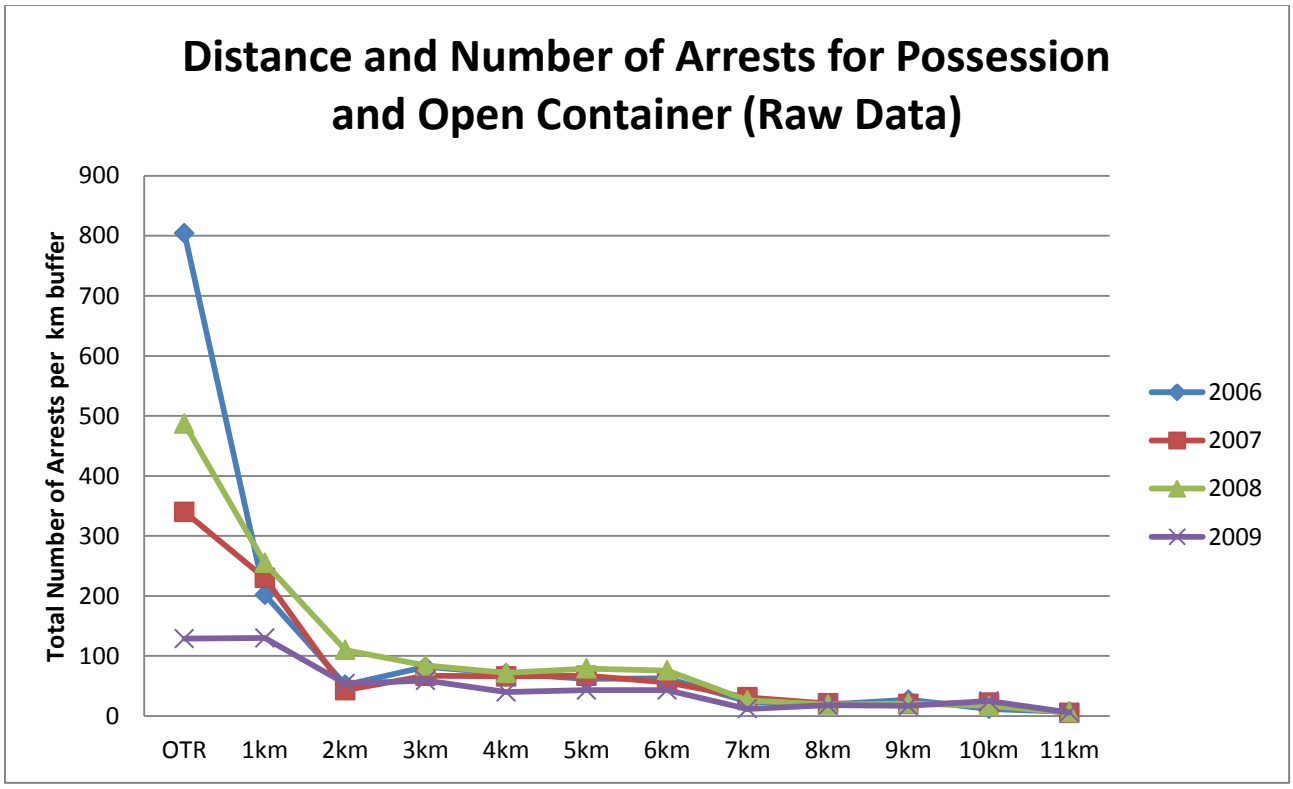


Figure 3. Distance and number of arrests for possession from 2006-2009, compared to distance from OTR.

The data points obtained from the calls for service database that were geocoded were then each spatially joined to the respective buffer of their occurrence, and then the counts of the numbers of robberies occurring per 1-kilometer buffer were tallied, and are illustrated below in Figure 4.

Table 2. Raw number of robberies per buffer from 2006-to-2009

	2006	2007	2008	2009
OTR	271	234	254	245
1km	275	258	266	267
2km	171	152	215	168
3km	159	137	173	156
4km	197	162	208	168
5km	196	173	237	243
6km	230	188	267	273
7km	157	110	124	124
8km	107	102	95	89
9km	98	71	105	97
10km	137	96	130	139
11km	71	75	89	93

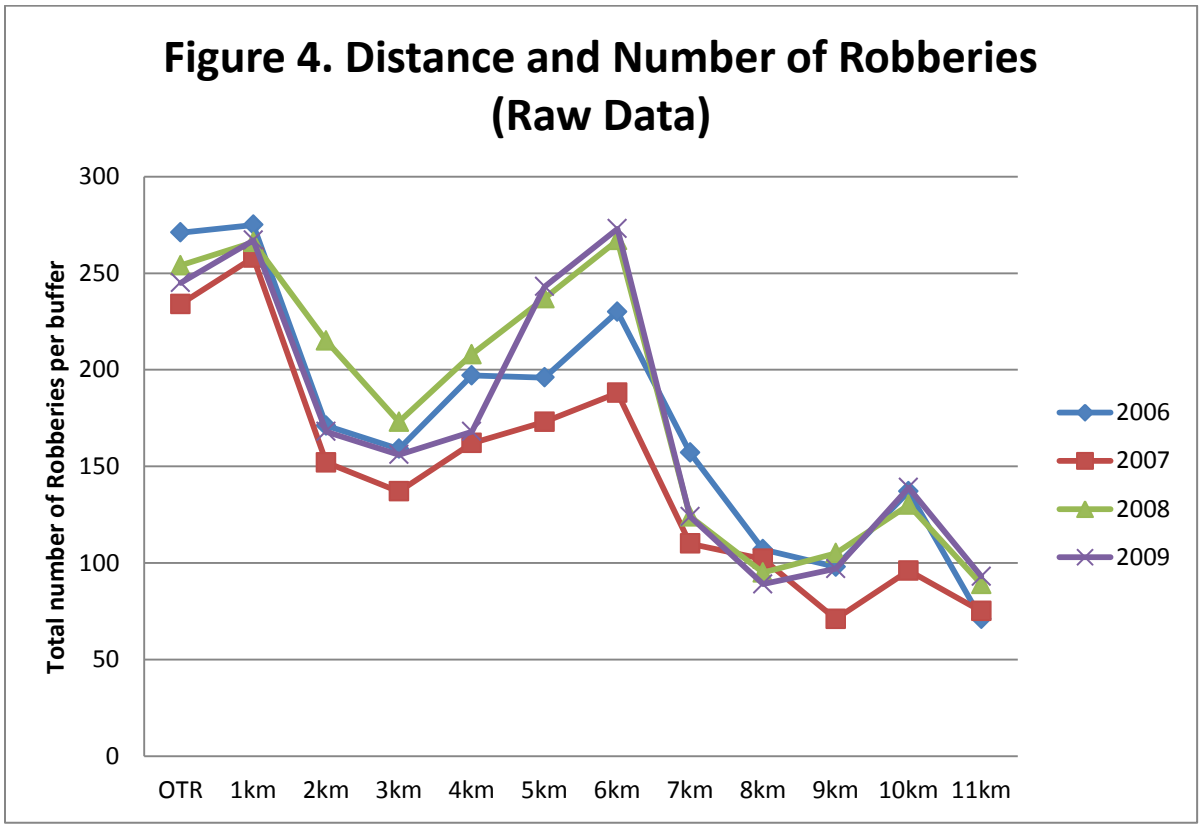


Figure 4. Distance and Number of Robberies (Raw Data)

The charting of these data in the above figure visually suggests that an overall reduction of robberies occurred in 2007, and that the frequency of robberies demonstrate a similar pattern throughout the entire time series (2006-2009). The largest frequency of robberies consistently occurs within the first buffer, a distance of zero to one kilometers from Over-the-Rhine, and then these frequencies gradually decrease through the third buffer (up to a distance of 3 kilometers), and from there the frequencies exhibit a significant upsurge at the sixth buffer (within the five to six kilometer distance from Over-the-Rhine). The location of this buffer and the neighborhoods through which it cuts is demonstrated below in Figure 5.

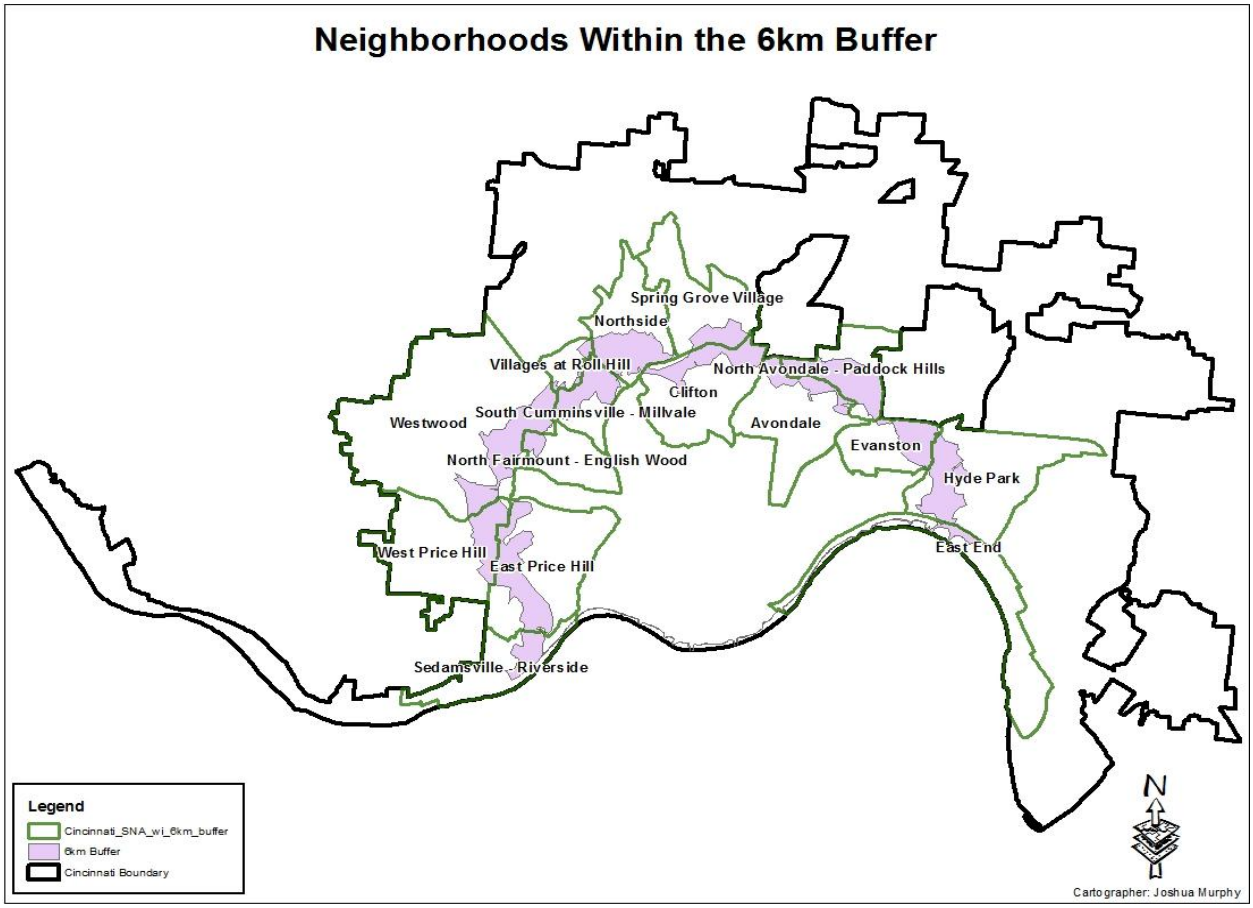


Figure 5. Neighborhoods within 6km buffer.

The 6-kilometer buffer cuts through Cincinnati neighborhoods of East Price Hill, West Price Hill, Westwood, South Cumminsville, Northside, Clifton, Avondale, Paddock Hills, Evanston, Hyde Park and East End. Some of these neighborhoods are likely not surprising to Cincinnati residents as being areas known for increased occurrence of crime, including robberies.

The relationship between the changes in the number of robberies from 2006 through 2009, normalized by the square-kilometer area of each buffer as the distance increases from the treatment area of Over-the-Rhine is shown below in Figure 6.

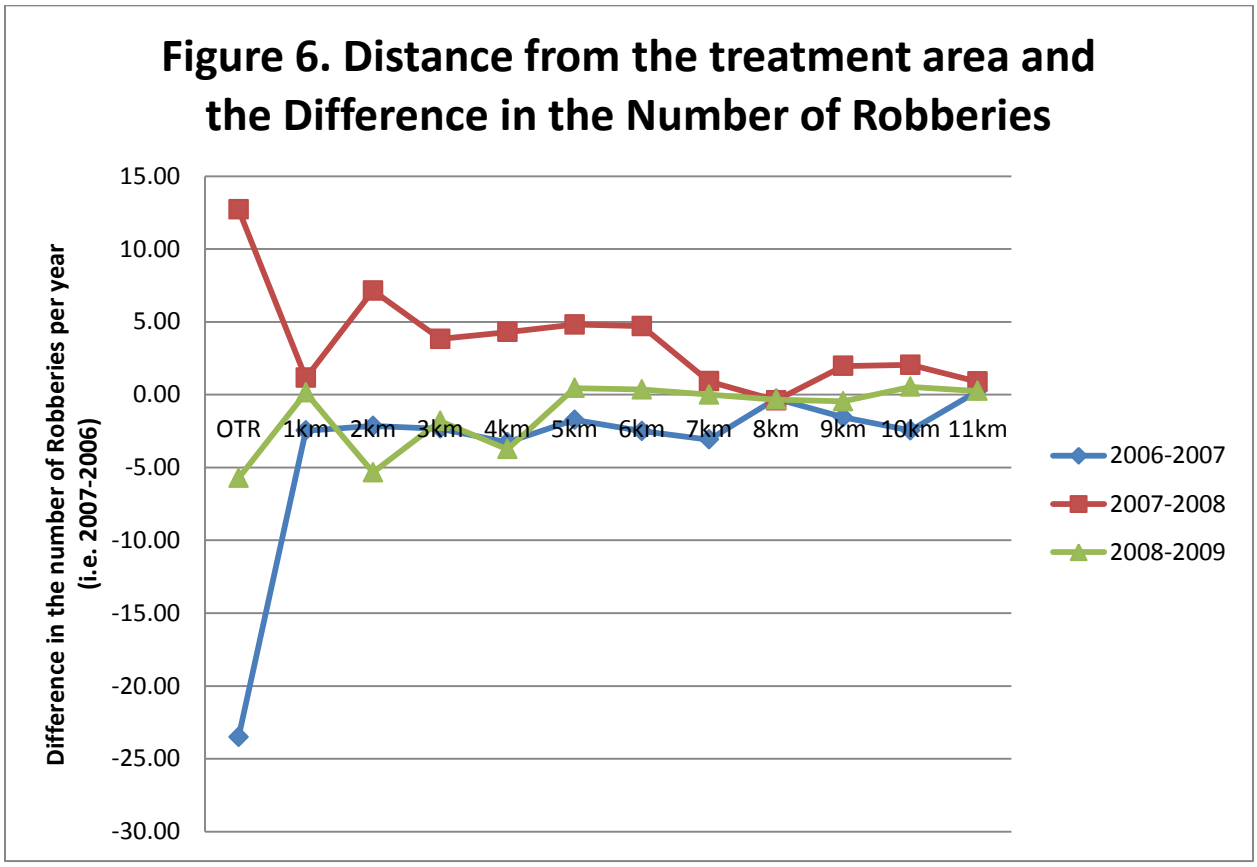


Figure 6. Normalized (by sq.km) Change in robbery from 2006-2009, compared to distance from OTR.

Operation Vortex was highly publicized, and during 2008, the year following its initial implementation, the difference between the number of robberies in 2007 and 2006 (depicted in Figure 6 in blue) in Over-the-Rhine is remarkably lower, having decreased substantially , and this effect on the difference in the number of reported robberies decays and nears zero throughout the remainder of the city. The red line in Figure 6 above represents the time period occurring two years after Operation Vortex (2009), and this line demonstrates the difference in the number of robberies between 2008 and 2007. For the first time, it is clear that there is an increase in the difference of reported robberies in Over-the-Rhine, with this difference being practically zero at the first buffer (zero to 1 kilometer) but then increasing immensely at the next buffer (1-2 kilometers), and then remaining consistently above average for the rest of the city, seen in the remaining buffers Three years after Operation Vortex (2010), the reduction in the number of reported robberies in Over-the-Rhine between 2009 and 2008, demonstrated in Figure 6 by the green line, is nearly one-fifth of that seen in 2007 and 2006. This difference is null at a 1-kilometer distance, and exhibits a slight decrease in the number of reported robberies at a distance of 2 kilometers and at 4 kilometers, and then near zero throughout the remainder of the city.

STWDQ Results

This study focused on the first two buffer zones, extending from zero to 2 kilometers from Over-the-Rhine, and employed Hall and Liu's (2009) STWDQ for that area, as demonstrated below in Figure 7. The first buffer zone (A) extends from zero to one kilometer (0-0.62 miles) from the network-converted boundary of the Over-the-Rhine neighborhood. Buffer zone (B) extends from one to two kilometers (0.62-1.24 miles) from this neighborhood boundary, and finally buffer zone (C) is the combination of both buffers A and B, extending the

range from 0-2 kilometers (0-1.24 miles). The control for is STWDQ in this study is the frequency of robberies from 2003-2004, the years just prior to the initiation of Operation Vortex.

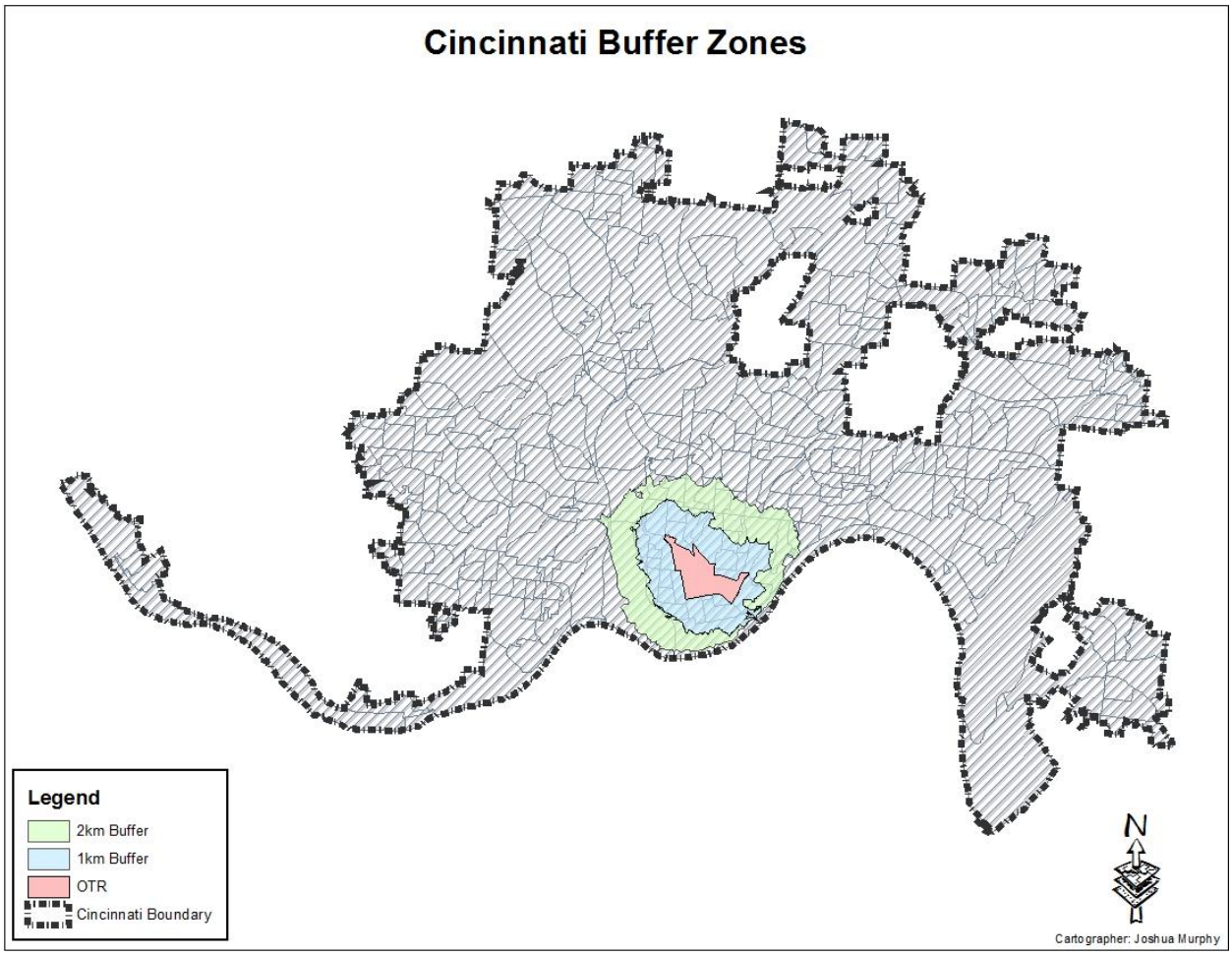


Figure 7. Buffer Zones used in STWDQ Formula.

Table 3. Raw number of robberies per Buffer Zones used in STWDQ Formula

	2003	2004	2006	2007	2008	2009
OTR	330	399	271	234	254	245
(0-1km)	331	333	275	258	266	267
(1-2km)	214	216	171	152	215	168

Table 4. STWDQ Results.

Buffers	STWDQ 1 | 06-07/03-04	STWDQ 2 | 07-08/03-04	STWDQ 3 | 08-09/03-04
0-1 km Buffer (A)	0.178618071	-0.19342562	0.01171498
1-2 km Buffer (B)	0.347938175	-2.51070449	1.457615163
0-2 km Buffer (C)	0.240146588	-1.16989269	0.579583643

STWDQ 1 compares the aggressive policing tactics employed from 2006 to 2007 with the non-aggressive policing style from 2003 to 2004. The scores of 0.178, 0.347, and 0.240 suggest that a rather small diffusion of benefits occurred in all three (A, B, & C) of the buffer areas.

STWDQ 2 compares the policing strategies from 2007 to 2008 against those of 2003 to 2004. The score of -0.193 suggests a rather small displacement of robberies occurring in Buffer A (0-1 kilometers). Additionally, the STWDQ score of -2.510 indicates an enormous displacement of robberies into Buffer B, the 1- to 2-km buffer area, equal to two-and-one-half times the benefits of Operation Vortex in Over-the-Rhine. Finally, the score of -1.169 indicates a displacement of robberies from the treatment area into the 0- to 2-km buffer area C greater the entire direct effects of the treatment in OTR.

STWDQ 3 compares the aggressive policing tactics employed from 2008 to 2009 with the non-aggressive policing style from 2003 to 2004. The score of 0.011 suggests that Operation Vortex did not lead to displacement or diffusion of benefits in Buffer A. Additionally, the score of 1.457 indicates a diffusion of benefits into Buffer B, equal to one-and-one-half times the effects in the treatment area Over-the-Rhine. Finally, the score of 0.579 suggests a diffusion of benefits equal to half of the direct effects of the treatment occurred within Buffer C.

Conclusion

The results of this research show that the difference between the number of robberies in 2007 and 2006 exhibits a tremendous decrease in OTR. The results of STWDQ1 corroborate that in 2006-2007, the year following "Operation Vortex," an overall reduction of crime occurred throughout the city center, supported by a diffusion of benefits occurring in all three (A, B, & C) of the buffer areas. Suggesting for this time period "Operation Vortex" was successful in reducing the number of robberies in OTR.

Through calculating the difference in the number of robberies between 2008 and 2007, we see for the first time an increase in the number reported robberies in OTR. By comparing the policing strategies from 2007 to 2008 against those of 2003 to 2004 this research has determined that an enormous displacement of robberies occurred within the 1- to 2-km buffer area (B) equal to more than two-and-one-half times the benefits of "Operation Vortex" in OTR, and a displacement of robberies from the treatment area into the 0- to 2-km buffer area (C) greater the entire direct effects of the treatment in OTR. Suggesting that for this time period, only two years later, robberies had been pushed into the periphery beyond the target area, or more simply stated, had "moved crime around the corner (Eck 1993)."

Three years after "Operation Vortex" the reduction in the number of reported robberies in OTR, between 2009 and 2008, is nearly one-fifth of that seen in 2007 and 2006 (approximately -5 robberies in comparison to -25). This difference is null at 1km, and a slight decrease in the number of reported robberies are seen at a distance of 2km and 4km and near zero throughout the remainder of the city. The STWDQ 3 results from this time period also indicate a diffusion of benefits into the 0-to-1km buffer and the 1-to-2km buffer.

It should be noted that this STWDQ index has been assumed to detect both a diffusion of benefits, or displacement of crime. While this index has been widely used in assessing the impact of aggressive policing, there is still conjecture by those in academia to whether or not this method is capable of making such an assumption based on these index values alone.

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