Crime Diffusion and Displacement: Measuring the Side Effects of Police Operations*

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In 2005, the Camden, New Jersey, Police Department responded to concerns about crime with a series of high-visibility, directed, uniform patrol deployment initiatives. The department deployed extra resources on overlapping shifts into hotspot areas to counteract trends in burglary, violence, and drug crime. In situations such as this, where police employ directed and geographically targeted enforcement initiatives, both police and the public are often concerned about displacement; however, until recently no standard tool for measuring displacement was available. The weighted displacement quotient, despite some acknowledged methodological concerns, represents for the first time a systematic approach to the measurement of geographical displacement of crime. Using the weighted displacement quotient as part of the evaluation of the Camden initiative, researchers found a marked decrease in crime in the target area and evidence of a diffusion of benefits to the surrounding displacement buffer zone. This article examines the use of the weighted displacement quotient in the analysis of varying types of crime and seeks to address some of the methodological and statistical concerns highlighted by previous researchers. In particular, this article addresses issues of buffer area selection and evaluation. The Camden initiative serves as a case study to demonstrate the technique, as it is applied to drug, vehicle, gun, and violent crime, as well as overall crime in targeted areas of the city. **Key Words: crime displacement, hot spot policing, weighted displacement quotient.**

2005 年，新泽西州卡姆登警察署对一系列高知名度，定向，统一部署巡逻行动的关注进行了回应。该部门把额外资源重叠部署在热点地区来抵消爆窃，暴力和毒品犯罪的趋势。在警察采用定向和地理针对性的执法行动的情况下，警察和公众都通常对位移很关注，但是，直到最近也没有可用的标准位移测量工具。尽管有一些公认的方法学问题，加权位移商第一次代表了犯罪地理位移测量的系统方法。使用加权位移商作为卡姆登倡议评价的一部分，研究人员发现目标区域犯罪明显减少和对周围位移缓冲区有益的扩散证据。本文探讨了加权位移商在不同的犯罪类型分析中的应用，并寻求解决以前研究人员强调的方法和统计方面的关注。特别是，本文讨论缓冲区域选择和评价的问题。把卡姆登倡议作为个案研究，以证明这项技术适用于药物，车辆，枪支和暴力犯罪，以及在有针对性的城市地区的整体罪案。**关键词：犯罪位移，热点治安，加权位移商。**

En 2005, el Departamento de Policía de Camden, Nueva Jersey, respondió a las preocupaciones sobre criminalidad con una serie de iniciativas de despliegue policial directo y alarde de patrullas. El departamento desplegó recursos adicionales para traslapar operativos sobre áreas calientes para contrarrestar la criminalidad reinante de asaltos a residencias, violencia y drogas. En situaciones como esta, en que la policía emplea iniciativas de fuerza específicamente dirigidas a ciertos espacios, tanto la policía como el público suelen inquietarse por el tema del desplazamiento; sin embargo, hasta hace poco no se disponía de una herramienta estándar para medir el desplazamiento. El cociente ponderado de desplazamiento, pese a algunas preocupaciones metodológicas reconocidas, por primera vez representa una aproximación sistemática para medir el desplazamiento geográfico

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del crimen. Utilizando el cociente ponderado de desplazamiento como parte de la evaluación de la iniciativa de Camden, los investigadores hallaron una marcada disminución del crimen en el área objetivo, lo mismo que evidencia de la difusión de beneficios en la zona circundante de amortiguación del desplazamiento. Este artículo examina el uso del cociente ponderado de desplazamiento en el análisis de variados tipos de crimen y busca abocar algunas de las preocupaciones metodológicas y estadísticas referidas por investigadores anteriores. En particular, el artículo confronta aspectos relativos a la selección y evaluación del área de amortiguación. La iniciativa Camden sirve como un estudio de caso para demostrar la técnica, en cuanto se aplica a crímenes relacionados con drogas, vehículos, armas de fuego y violencia, lo mismo que sobre criminalidad general en áreas objetivo de la ciudad. **Palabras clave: desplazamiento criminal, puntos calientes de control policial, cociente ponderado de desplazamiento.**

It has long been argued that crime moves in response to targeted law enforcement (Repetto 1974; Hakim and Rengert 1981; Barr and Pease 1990), although the empirical evidence is often less convincing than the rhetoric (Eck 1993; Hesseling 1994). Attempts to counter discussions of the negative effects of targeted enforcement have argued that such strategies can actually result in a diffusion of benefits rather than a displacement of crime, whereby the crime reduction benefits of the police operation spill over into areas not directly targeted by the law enforcement action (Clarke and Weisburd 1994; Green 1995; Ratcliffe 2002). Until recently there has been no systematic approach to acquiring empirical support for either side of the argument, although there has been a need for a methodology that is robust enough to clarify any displacement or diffusion of benefits while being simple enough for broad applicability across a range of situations and user abilities. The introduction of the weighted displacement quotient (WDQ) from Bowers and Johnson (2003) attempted to address many of these issues.

As of yet, the WDQ has not garnered the widespread application and usage it deserves. This might have been influenced by methodological concerns and issues of statistical significance originally identified by Bowers and Johnson (2003). However, the WDQ, when employed as a step in the process of understanding the spatial effects of targeted enforcement, could become an invaluable tool for the evaluation of law enforcement operations, and concerns regarding statistical significance can be addressed through a series of simple statistical tests on the data.

This article begins by reviewing the theoretical and empirical foundations that have spurred interest in displacement and diffusion and explores the importance of quantifying these features of the criminal event landscape. We then provide a short overview of the WDQ and examine the implications of buffer selection approaches. The appropriate selection of a buffer zone in a crime prevention scenario is a nuanced approach requiring an appreciation for both local geographical conditions as well as an understanding of the tenets of environmental criminology. In addition to the WDQ, we identify how some simple statistical methods can enhance understanding of the WDQ and test the robustness of the chosen buffer area. Finally, to demonstrate the applicability of this methodology, we provide a case study from a police crime suppression operation from Camden, New Jersey.

Displacement and Diffusion

Crime incidents are neither uniformly distributed over space nor randomly distributed. Rather, they occur in clusters. From as far back as the cartographic school in nineteenth-century France (Guerry 1833; Quetelet 1842) and the Chicago school of sociological inquiry (Burgess 1925; Shaw and McKay 1942) numerous researchers have identified various sociological, temporal, and behavioral characteristics of offenders and crime locations that inform the nonrandom nature of crime clustering (see Chainey and Ratcliffe [2005] for an overview of these research traditions). Building on both routine activities theory (Cohen and Felson 1979; Felson 1998) and the rational choice perspective (Cornish and Clarke 1986, 1987; Clarke and Felson 1993), Brantingham and Brantingham (1993a) presented the idea that crimes occur as criminally motivated individuals come into contact with suitable victims or targets as they travel between places and through areas that are known to them and wherein they are comfortable (*awareness spaces*). Further, they stated that within cities "criminal behavior is highly patterned and frequently

localized" (Brantingham and Brantingham 1993b, 5). Based on the design characteristics of urban areas and how demographic and socioeconomic groups cluster therein, certain areas will experience disproportionate amounts of particular types of crime (Brantingham and Brantingham 1993a). This idea, combined with place-specific attempts by crime prevention practitioners to reduce crime, is central to concerns over the displacement of crime.

The central tenet of displacement concerns is that criminally motivated offenders, when prevented from committing crime at a particular location or in a particular way, will not be dissuaded from criminality but will simply be displaced to commit crime in some other manner. Repetto (1974) and Hakim and Rengert (1981) identified five forms of displacement as the result of blocked criminal opportunities. The first three are *temporal displacement* where the time of the offense changes, *spatial displacement* where the location changes, and *target displacement* where the target changes. Further forms of displacement include *method displacement*, where the method the offender uses to commit the offense changes, and finally *type displacement*, where the offender changes from one type of offense to another (Repetto 1974; Hakim and Rengert 1981). From the perspective of action-oriented researchers aiming for a crime prevention outcome, Barr and Pease (1990, 278) took a more theoretical approach in considering displacement as both "a frustrating side effect" and "a predictable effect of specific policies and . . . a manipulative tool of crime control." They concluded that displacement or deflection of crime is simply a reorganization of the space and time in which a potential offender comes in contact with a potential victim, and that "displacement . . . is valuable not only for the planning of short-term strategies, but because it illuminates the choices that have been made which lead to the present pattern of crime" (311–13). Most studies of displacement tend to test for spatial displacement (Hesseling 1994); however, in a rare nonspatial example, Yang (2008) focused on economic risks and loss resulting from changes in Philippines customs procedures, identifying predominantly method displacement, where changes and increases in enforcement of customs procedures caused adaptations in methods of evasion of duty payments.

Spatial displacement, the central subject of this article, is often articulated by practitioners and some researchers as a negative outcome from a crime prevention operation. Ratcliffe (2002) cited a number of examples of researchers who have encountered a negative response of practitioners to suggestions of displacement. The general concern expressed is that displacement eliminates the effectiveness of crime reduction operations by pushing crime to nearby areas or other crime types. This assumption is often predicated on the overly optimistic notion that without the displacement no crime would have occurred at all, a notion that places greater faith in crime prevention strategies than evaluations suggest is warranted. As Clarke (1995) noted, "the uncritical acceptance of displacement . . . may also mean that increases in crime, which might have occurred anyway, have sometimes been wrongly attributed to displacement" (123). The common—although incorrect—view that displacement is inevitable, does not result in any net reduction in crime, and is a negative outcome of a crime prevention operation has not been effectively countered by a research tradition that although blessed with evidence, lacks appropriate tools and a public voice.

Where displacement does occur, it is usually the result of situations that force offenders to access nearby opportunities not within the confines of the operation. Where offenders are forced into secondary and, by implication, less effective target choices, this will theoretically result in less crime. This idea was echoed by Eck (1993), who in his summary of thirty-three studies of crime displacement found that "displacement is least likely to occur in the direction of unfamiliar places, times, targets and behaviors"; what he termed "familiarity decay" (Eck 1993, 537). He concluded that "prevention and crackdown efforts focused on unique situations will have less displacement than prevention or crackdown efforts focused on general situations" (Eck 1993, 537).

Empirical evidence supports a lack of total displacement. For example, both Hesseling's (1994) meta-analysis and Ratcliffe's (2005) empirical work in Canberra have concluded that displacement is not an inevitable outcome of a police crackdown or crime suppression operation. Green (1995), while examining the impact of a specialized multiagency response team on

drug and disorder problems in Oakland, California, examined individual-level data to explore how offenders moved between targeted areas and exterior, catchment areas. Her research found that 13 percent of target sites became worse, but 76.6 percent improved, and that when catchment areas were paired with the target areas, 40 percent of sites improved in both the target and catchment areas.

Cornish and Clarke (1987) conceptualized displacement from the perspective of rational choice theory. From their examination of the choices made by offenders in the decision to commit crimes and their choice of targets, they believed that displacement could best be explained and understood by concentrating on the offender's personal decisions and choices made in the commission of crime. The decisions, opportunities, costs, and benefits associated with particular offenses, in Cornish and Clarke's view, work to establish the confines of displacement within different categories of offense. If this is the case, then it becomes less plausible to justify a generalized approach to displacement and requires practitioners and researchers to be open to the possibility that displacement might or might not occur with different spatio-temporal (and other displacement typology) characteristics for different crime types and situations.

This raises the specter that displacement areas might not be uniform, with the corollary that the spatial context of the wider environment surrounding a crime prevention operation must be considered. We return to this important point later.

Diffusion of benefits is "the spread of the beneficial influence of an intervention beyond the places which are directly targeted, the individuals who are the target of control, the crimes which are the focus of intervention or the time periods in which an intervention is brought" (Clarke and Weisburd 1994, 168). Ratcliffe and Makkai (2004) identified two types of diffusion of crime control benefits: deterrence and discouragement. *Deterrence* relates to an increase in the potential offender's perceived risk of apprehension, and *discouragement* relates to an increase in the perceived effort required to complete the criminal act (Ratcliffe and Makkai 2004). Both mechanisms are capable of reducing crime in areas not specifically targeted by a crime reduction policy because the levers they pull relate to offender perception rather than increases in actual risk or actual effort to commit crime.

Evidence for diffusion of benefits can be found in Weisburd and colleagues' (2006) social observations and ethnographic research that examined immediate displacement and diffusion effects of Jersey City interventions focused on prostitution, disorder, and drug market activity. They found a tendency among those they interviewed to resist moving and reestablishing their prostitution or drug activity in another location. Further, they noted statistically significant trends in target and catchment areas regarding the decline of disorder offenses, leading to the conclusion that the crime control efforts diffused into the areas surrounding the target sites (similar trends were seen with prostitution and drugs, although the trends in drug crime lacked statistical significance). Their results supported rational choice and routine activity as theoretical explanations, as well as giving credence to Eck's (1993) concept of familiarity decay.

However, with the exception of a few papers, we concur with the view of Hesseling from over a decade ago that most of the extant research lacks interest in, or intent to seek, evidence of a diffusion of benefits (Hesseling 1994). This situation remains today, even with the explosion in recent years of the use of geographic information systems (GIS) and GIScience within policing and criminal justice research. This is unfortunate given that "actively seeking out evidence of this benefit will assist law enforcement in justifying operational expense, and planning future crime-reduction strategies" (Ratcliffe and Makkai 2004, 6). Beyond the pragmatic policing and crime reduction benefits, there is also the possibility of increasing the theoretical understanding of offender response to targeted policing strategies.

Bowers and Johnson (2003) sought to quantify these complementary theoretical views of displacement and the diffusion of benefits in targeted enforcement. Their study of twenty-one burglary prevention programs in northern England concluded that the WDQ "provides a systematic way of measuring the geographical displacement of crime," despite methodological and statistical issues due in part to the novelty of the technique (Bowers and Johnson 2003, 300). The remainder of this article is an

attempt to build on the work of Bowers and Johnson, provide additional functionality to assist in this endeavor, and expand on previous research by examining both displacement and diffusion effects as they pertain to other crime types (namely, drug, vehicle, and violent crime) in the city of Camden, New Jersey.

The Weighted Displacement Quotient

In this article, Bowers and Johnson's (2003) WDQ will be employed to determine whether or not differences between the target and the buffer areas are a result of displacement from the target area or a diffusion of benefits from the increase of police presence within the target area. The determination of a WDQ first requires the researcher to determine three operational areas: the target area where the crime reduction strategy has been deployed, a buffer area that is estimated to be the most likely location to which crime would be displaced, and a control area that acts as a check on general crime trends that are affecting the region in general. The equation for the WDQ is as follows:

$$\text{WDQ} = (B_{t1}/C_{t1} - B_{t0}/C_{t0})/(A_{t1}/C_{t1} - A_{t0}/C_{t0}) \quad (1)$$

where A is the count of crime events in the target area, B is the count of crime events in the buffer area, C is the count of crime events in the control area, $t1$ is the time of the intervention, and $t0$ is the pre-intervention time period (Johnson and Bowers 2003). The examination of the difference between the buffer and control areas from the pre-intervention to the intervention (or post-intervention) period provides the measure of displacement or diffusion into the buffer area, and the differences between the target and control area ratios at both times provide the measure of success for the intervention (Johnson and Bowers 2003). Equation 1 is therefore comprised of both a buffer displacement measure ($B_{t1}/C_{t1} - B_{t0}/C_{t0}$) and a success measure ($A_{t1}/C_{t1} - A_{t0}/C_{t0}$). A positive buffer displacement measure is indicative of potential displacement, whereas a negative value indicates possible diffusion of benefits. A positive success measure indicates that crime levels did not improve as a result of the intervention, whereas a negative success measure suggests that the police operation (or other form of intervention) was successful in reducing crime. In the case study that follows, these are both reported. With regard to interpretation of the WDQ value, Bowers and Johnson (2003) provided a useful table, reproduced here as Table 1.

The purpose of this research is to expand on Bowers and Johnson's WDQ by adding to the discussion on buffer selection and introducing ways to apply measures of statistical significance to the WDQ. The evaluation of the Camden initiative is a case study demonstrating these statistical processes and it provides an example for other evaluators of police programs to familiarize themselves with a relatively new tool for examining displacement and diffusion.

Buffer Selection Issues

A question that continually arises among crime analysts is a method of determination for the buffer area. Although a buffer can be easily defined as "a specified area around a feature on a map" (Boba 2005, 43), in the minds of most GIScientists, a buffer is most commonly visualized as a uniform polygon shape that extends around an object. Most GIS programs contain

Table 1 *Interpretation of weighted displacement quotient (WDQ) values*

WDQ value	Interpretation	
WDQ > 1	Diffusion greater than direct effects	Positive net effect of the program
WDQ near 1	Diffusion about equal to direct effects	
1 > WDQ > 0	Diffusion but less than direct effects	
WDQ = 0	No displacement or diffusion	
0 > WDQ > –1	Displacement but less than direct effects	
WDQ near –1	Displacement about equal to direct effects	No net benefit to program
WDQ < –1	Displacement greater than direct effects	Program worse than doing nothing

Source: Bowers and Johnson (2003, 286).

subroutines that permit the creation of buffers of uniform size. Although it might appear to be easiest to decide on a certain number of street blocks from the edge of the target area and create a uniform buffer of that distance around the target zone, such a decision could fail to take into account several factors. For the purposes of a WDQ of crime, a more nuanced selection of the buffer area, a selection that is neither arbitrary nor uniform in dimension might be advisory.

First, an arbitrary buffer zone of a set distance can result in the inclusion of certain elements of urban geography that lie beyond features that naturally hinder movement or act as natural borders and barriers: a park, a busy thoroughfare, a river or canal, and so forth. In such cases, these natural breaks in the urban mosaic act as "perceptual edges" (Brantingham and Brantingham 1993b, 17), places beyond which offenders might feel less comfortable in committing crime. The inclusion of territory beyond these edges might artificially increase the crime count associated with the buffer by including offenses that are not the result of displacement. In a similar vein, it is also possible that buffers that are too expansive could include perceptual edges that are not natural effects, such as neighborhoods of different socioeconomic status or gang territories. These different types of perceptual boundaries can act as edges that hinder offender movement. Therefore, from the perspective of Equation 1, if the buffer area is too large, incorporation of geography that is not a natural displacement area will result in the inclusion of crime events in the B areas that are unrelated to potential displacement or diffusion.

Conversely, failing to incorporate sufficient territory into a buffer zone runs further risk of quantitative error. Buffer areas that are too small will have the effect of failing to consider all potential displacement or diffusion outcomes. In other words, events that were potentially displaced from the target area will be recorded not in the buffer area (B) but potentially in the control area (C) of Equation 1. This would have the negative outcome of both failing to recognize the displacement taking place and overinflating the value of C_{t1}, with the concomitant problem of potentially overestimating the crime reduction benefits of the intervention.

It is also important to know what areas are monitored by closed circuit television, neighborhood groups, or other informal or formal social controls, especially if the WDQ is being utilized to determine the benefit of a particular initiative. In such cases, a decline in crime in either a part of the target area or the buffer area could be due to the prevalence of crime prevention tactics unrelated to the intervention under examination. If additional prevention measures are applied to the buffer and crime falls as a result, a decrease in crime in the target area might be misinterpreted as not outperforming the buffer, when in actuality two different programs are being included in the evaluation at once.

A final consideration for buffer selection is that it is not a requirement that a buffer area be contiguous with the target area. It is possible that an offender displaced from one housing project might choose to traverse through an area of industry or commercial use before displacing his or her activities to another housing project on the far side of the nonresidential land use area. As such, analysts should be cognizant of the possibility of remote buffer areas.

In summary, it is valuable for the researcher employing the WDQ to be aware of the features of the target area and surrounding areas and to focus on natural and man-made boundaries in and around those areas, as well as determining the social and crime-related boundaries through discussions with local law enforcement and other criminal justice agencies. The assumption of isotropic geographical space (Tobler 1993) might be incorrect when placed in the context of predicting likely displacement or diffusion of benefits resulting from crime prevention activity. There are no firm rules for selection of buffer areas, but as we demonstrate in the case study that follows, we were able to combine local knowledge with theoretical knowledge regarding offender behavior to determine context-specific buffer areas.

Statistical Significance

One of the primary concerns in regard to the WDQ is the lack of a measure of statistical significance for the outcomes of the calculation. This problem is grounded in the tendency of ratio calculations, such as the WDQ described in Equation 1, to dissolve to an n of 1. Although

it can be argued that there are many calculations whose statistical significance is taken for granted that possess the same problem, at present this concern can be partially addressed in the following ways.

The simplest approach is to examine the statistical significance of the data themselves, prior to proceeding to the WDQ measurement. Two specific questions come to mind: Is there a statistically significant difference between the amount of crime in the target area before the initiative as compared to during (or after) the initiative? Is there a statistically significant difference between crime in the buffer area and the target area? These are logical questions leading to the use of the WDQ.

To address these questions it is possible to employ a 2 × 2 chi-square. The 2 × 2 chi-square is preferable to a 3 × 3 chi-square (one that would incorporate the control area as well as the target and buffer areas) because in many crime analysis situations the control area is likely to be considerably larger than the buffer and target areas. For example, in the Camden example that follows, the control area was the rest of the city, allowing for changes in crime in the buffer and target areas to be compared to the city. In a 3 × 3 chi-square, this would have the effect of swamping any target–buffer variation by dominating the statistic with citywide measures. By employing a 2 × 2 chi-square it is possible to determine an indication of whether or not the differences between the target and buffer areas before and during the initiative could have happened as a result of random variation in crime frequencies.

In situations where the crimes of interest occur more infrequently, yielding smaller numbers, the Fisher's exact test (Fisher 1922) can be employed to determine if there is a statistically significant relationship between what has happened in the buffer area and what has happened in the target area. Unlike the chi-square, Fisher's exact test can only be employed in a 2 × 2 table, precluding the possibility of using either 3 × 3 or 2 × 3 options.

A preferable step (and the method selected for this article) in determining the statistical significance of the data prior to employing the WDQ is the phi statistic. This statistic can be specifically applied to the question: Is there a statistically significant difference between crime in the buffer area and the target area? The phi statistic[1] is used to measure the level of association or strength of the relationship between the target and the buffer areas and is shown in Equation 2.

$$\Phi = \sqrt{(x^2/N)} \tag{2}$$

If the phi is close to zero (between 0 and 0.1), there is deemed to be no predictive measure of association between the target and buffer areas. This is a positive result in terms of concerns about displacement and diffusion. Neither displacement nor diffusion is inherently predictable. Although there is an increased awareness of diffusion of benefits among police practitioners, the reality is that targeted enforcement programs are rarely initiated because of the possibility of positive or negative effects on areas surrounding the targets. These programs are initiated to address specific location-based crime problems. If the phi is between 0.1 and 0.3, there is a moderate (positive or negative) association and the buffer area might need to be reexamined and redelineated. If the phi is over 0.3, there is a strong positive (or negative) association, such that a decrease in one can be expected to be automatically related to a decrease in the other (or vice versa). If a phi value over 0.3 is observed, there might be no inherent reason to run the subsequent WDQ because it is likely that displacement or diffusion has been an automatic outcome of the operation due to the close association between target and displacement area. With these statistical checks in place one is able to employ the WDQ with more confidence.

The WDQ is enhanced by the use of the phi, in particular because of the difficulty in determining an appropriate buffer area. Phi values below 0.3 can reassure the researcher that the buffer is sized such that there is not a direct or predictable correlation between the areas and that there is no assumption that spatial autocorrelation is present. This is important because of the common assumption among many criminal justice practitioners that displacement is an automatic outcome of any spatially localized crime prevention initiative. Notwithstanding the lack of evidence to support this notion, the myth of displacement maintains a depressing currency among practitioners. As a result, there is value in a test statistic such as the phi

to enable researchers to confirm that target and displacement areas appear to operate independently and that any displacement (or diffusion) is not a foregone conclusion.

We now proceed with the evaluation of a crime suppression operation conducted by the Camden Police Department (CPD).

The Camden Twenty-Eight-Day Crime Suppression Operation

The city of Camden, New Jersey, covers an area of 8.82 square miles with a population of 79,904 (as measured in 2000), of which approximately 48.5 percent are male with an average resident age of thirty. The population is approximately 53 percent black and 39 percent Hispanic. The total number of housing units within Camden in 2000 was 29,769, of which 43.9 percent were rental properties and 37.3 percent were occupied by the property owner.

Publisher Morgan Quinto's annual ranking of crime in U.S. cities ranked Camden as the most dangerous city in America for two years (2004 and 2005), and Camden has only dipped below the top five twice since 2000 (see for example, Morgan, Morgan, and Boba 2009). According to the Uniform Crime Reports (UCR) submitted to the Federal Bureau of Investigation (FBI), in 2007 Camden experienced forty-two murders, sixty-seven reported rapes, 781 robberies, 865 aggravated assaults, 1,128 burglaries, and 1,161 motor vehicle thefts. In an assessment of crime in 2008, Camden again ranked as the most dangerous city in America (Morgan, Morgan, and Boba 2009). It is currently also the poorest city in America. The 2000 median income was $23,421, and the city's population has few employment prospects. Of the population over twenty-five, 28.6 percent of the 2000 population had graduated high school or attained a GED, 17 percent had completed some college, and 3.5 percent had completed a bachelor's degree.

As 2004 rolled into 2005, the CPD began crime suppression operations across a number of areas in the city. Here we examine the impact of one such operation. During the operation additional police officers were targeted to provide high-visibility uniformed patrols in particular street corridors and at known crime hotspots. The CPD deployed extra resources on overlapping shifts into hotspot areas to counteract trends in burglary, violence, and drug crime. Although the operation was modeled on a process called the Baltimore twenty-eight-day plan, and the operation retained that name, the first part of the operation took place (in the dark red area of the larger map shown in Figure 1) for seven weeks. For the purposes of this article, we are interested in the evaluation of this period of the overall operation (later components of the operation continued in different areas for a number of months afterward). We therefore have three seven-week periods that can be compared:

1. Before: Seven weeks before the operation started (3 November 2004–21 December 2004).
2. During: The operational period (22 December 2004–8 February 2005).
3. After: The post-operation period (9 February 2005–29 March 2005).

Crime incidents were drawn from the incident database of the CPD. Our evaluation work in Camden was focused on incidents rather than recorded UCR offenses per se. In the main, these two categories usually result in equal counts; however, there are occasions where the incidents undercount the number of reported UCR offenses. For example, it is possible that one incident will result in two people being the victim of an aggravated assault. UCR figures, as reported to the FBI, will show two victims, whereas our incident database—which records the most serious UCR category for the individual incident—would show a single value. The advantage of our approach from an operational perspective is that we are able to assess the number of actual incidents to which police are required to respond, without overcounting due to the number of victims. In reality, these two counting methods are so similar as to allow us to consider the differences negligible for the purposes of this study.

Buffer Selection

Figure 1 presents the targeted area for the Camden crime suppression area. The target area is composed of problem corners and street blocks determined by the CPD commanders prior to the involvement of the evaluation team. For the purposes of the analysis, the target area was formatted to follow the patrol

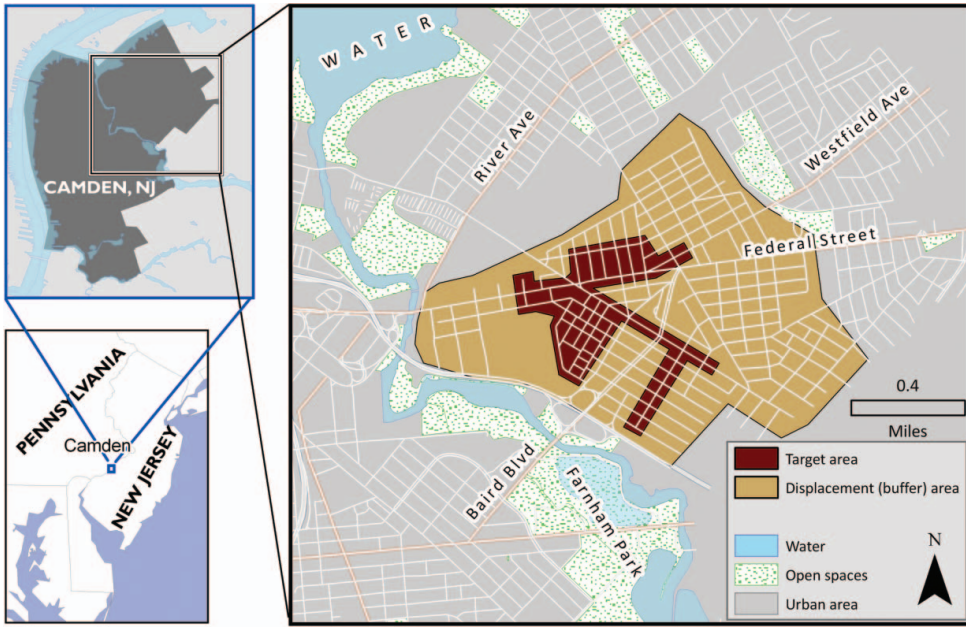

Figure 1 *Target and buffer displacement areas in Camden, New Jersey.*

patterns for the areas, as well as to include command posts and areas where officers were stationed for deterrent effects. Through extensive discussions with the officers and commanders responsible for carrying out the crime suppression plan, the buffer area was drawn to include the farthest distance they believed an individual was likely to travel to commit an offense if he or she was displaced by police activity from the target area, simultaneously incorporating elements of environmental criminology theory. The presence of natural and man-made boundaries around the target area was compared to the distances highlighted by the officers; they included a river to the southwest, marshes and some derelict open spaces in the southeast and northwest, a park in the northeast, and so forth. In this way, the evaluation was able to incorporate a context-specific buffer that included environmental constraints, gang territories, socioeconomic edges, and facets of criminal behavior.

Although we did not test alternative buffer areas, the suitability of the buffer was tested with the phi calculation across all crime types examined, as reported in the results that follow. The results show that the buffer, derived from theoretical and practical input, appears to operate independent of the target zone such that any reductions in the buffer zone are not simply a spatially autocorrelated corollary of crime changes in the target zone, but appear to be associated with the police operation.

Results

Results are presented for four crime types: violent crime, drug offenses, vehicle crime, and burglary. First, it can be seen from Tables 2 through 6 that the phi calculation is close to zero for all tables with the exception of

Table 2 *Impact on violent crime*

	Before vs. during	Before vs. after
Phi	0.025	0.005
% change in target area	Up 7.7%	Down 23.1%
% change in buffer area	Down 53.8%	Down 34.6%
% change in control area	Up 6.6%	Up 3.9%
Buffer displacement measure	–0.097	–0.063
Success measure	0.001	–0.022
WDQ	–108.545	2.854
Combined buffer and target	Down 33.3%	Down 30.8%

Note: WDQ = weighted displacement quotient.

burglary, as noted in Table 5. As regards the substantive crime results, Bowers and Johnson (2003) argued that positive success measures are indicative of a failed attempt to reduce crime on the part of the intervention, and thus it is theoretically inappropriate to examine the results further for evidence of displacement or diffusion; however, for completeness we include these results in the tables that follow. Table 2 shows the results from the analysis of violent crime before, during, and after the seven-week police operation.

Violent Crime

As Table 2 shows, there was a 7.7 percent increase in violent crime in the target area during the operation. There was a similar upturn in violence in the rest of the city (up 6.6 percent), however, and the operation seemed to have had a substantial benefit on the buffer area during the operation. A displacement effect, illustrated by a negative value in the WDQ, was found by comparing the weeks before the operation to the operational period. In essence, comparing the pre-operational period to the operational period, there was relatively no change in the target area (compared to the control area) but an improvement in the buffer area.

We can also examine the effect of the operation for the seven weeks after it ended. By comparing the period after the operation with the period preceding the intervention, it is possible to explore the possibility of residual deterrence after the operation (Sherman 1990). Compared to the seven weeks before the operation, the post-operation period saw a decrease in violent crime in both the buffer area and the target area, especially when compared to the different direction of the city crime level (rightmost column of values in Table 2). The target area was down over 20 percent and the displacement zone down over 30 percent from pre-operation levels. This is verified by a success measure that indicates a positive impact of the operation; furthermore, a WDQ value greater than one shows a diffusion of benefits to the buffer area greater than the benefit within the target area itself.

Drug Crime

Recorded drug crime initially increased, as it did throughout the city. This is to be expected:

Table 3 *Impact on drug crime*

	Before vs. during	Before vs. after
Phi	0.024	0.017
% change target area	Up 81%	Down 66.7%
% change buffer area	Down 31.6%	Down 42.1%
% change control area	Up 7.7%	Up 36.1%
Buffer displacement measure	–0.045	–0.07
Success measure	0.092	–0.102
WDQ	–0.486	0.689
Combined buffer and target	Up 27.5%	Down 55%

Note: WDQ = weighted displacement quotient.

Drug crime is generally only recorded when detected by police and more police in an area will often result in an increase in drug detections. As Table 3 shows, the number of recorded drug crimes increased by a fairly spectacular 81 percent from the pre-operation period. It went down in the buffer area. Comparing the before-operation period to the after-operation period, however, there is a marked decline in recorded drug crime. This decline also shows in the WDQ as an improvement in the buffer area, although the buffer area did not receive as much benefit as the target area. The WDQ in this instance falls between 0 and 1 and as such (and drawing on the Bowers and Johnson [2003] table reproduced in this article as Table 1) the diffusion is considered less than the direct effects experienced within the target area.

Vehicle Crime

Recorded vehicle crime incidents (Table 4) declined slightly during the operation and

Table 4 *Impact on vehicle crime*

	Before vs. during	Before vs. after
Phi	0.001	0.006
% change target area	Down 5.3%	Down 31.6%
% change buffer area	Down 2.4%	Down 7.3%
% change control area	Down 43.6%	Down 30.4%
Buffer displacement measure	0.094	0.043
Success measure	0.04	–0.001
WDQ	2.317	–42.535
Combined buffer and target	Down 3.3%	Down 15%

Note: WDQ = weighted displacement quotient.

substantially after the suppression period. They also reduced slightly in the buffer area. However, during the operation, vehicle crime declined substantially across the city in general. This decreased any measured displacement or diffusion by comparison, as the city outperformed the target area. Further, the WDQ for this time period is greater than one, leading to the conclusion that there was a greater diffusion of benefits from the target area than direct benefit to the target zone. Comparing the pre-operational period to the post-operational period, the target area slightly outperformed the city, but the post-operational period saw less benefit to the buffer area. In actuality, the WDQ for these time periods suggests a possible displacement of vehicle crime into the buffer area.

Burglary

Burglary declined in all areas during the operation, with the target area performing much in line with the reduction across the city during the same period (Table 5) and with considerable improvements within the buffer area. When comparing before the operation with afterward, the reduction in burglary doubled the reduction in the remainder of the city, and collectively the target and buffer area reduced in burglary by one third, with slight evidence of diffusion to the buffer, though with the caveat that the high phi value would suggest a degree of spatial autocorrelation confounding this diffusion result. During the operational period, the WDQ showed that this diffusion of benefits into the buffer area was less than the immediate effects within the target area, as indicated by a WDQ between 0 and 1. This level of diffusion was maintained after the operational period. The WDQ increased but not to the point that a greater diffusion effect might have occurred in the buffer area. Overall, the net benefit of the operation, as it pertained to burglary, remained within the target area. Unfortunately, with the burglary results, it cannot be assumed that the diffusion benefits were the result of the police operation, because the high phi statistic suggests spatial autocorrelation rather than a direct diffusion of benefits.

Combination of All Crime Types Examined

When examining all of these crime categories collectively (violent, vehicle, drug crime, and burglary) in the target area, recorded crime got worse during the operation compared to before the operation, but the picture is not necessarily a gloomy one (Table 6). Much of this increase in recorded crime is to be expected: When police are actively paying attention to an area, it is possible that the public will respond by reporting more crime. Police activity or presence is therefore partially responsible for pushing recorded crime higher. Second, some of the increase is due to increases in detected offenses, such as drug crime, and this increase is therefore reflective of greater police activity.

The city in general experienced a substantial drop in crime during this period, but the buffer zone saw a greater improvement and the combined buffer zone and target area saw a net reduction in crime beyond the citywide decrease, suggesting the possibility of some diffusion of benefits (and unlike the burglary results, the

Table 5 *Impact on burglary*

	Before vs. during	Before vs. after
Phi	0.869	0.694
% change target area	Down 20%	Down 50%
% change buffer area	Down 40%	Down 26.7%
% change control area	Down 16.5%	Down 23.9%
Buffer displacement measure	–0.039	–0.005
Success measure	–0.004	–0.032
WDQ	0.206	0.322
Combined buffer and target	Down 32%	Down 36%

Note: WDQ = weighted displacement quotient.

Table 6 *Impact on all four types of crime combined*

	Before vs. during	Before vs. after
Phi	0.007	0.004
% change target area	Up 23.8%	Down 44.4%
% change buffer area	Down 26.7%	Down 23.8%
% change control area	Down 18.4%	Down 8.3%
Buffer displacement measure	–0.014	–0.023
Success measure	0.044	–0.034
WDQ	–0.318	0.686
Combined buffer and target	Down 7.3%	Down 31.7%

Note: WDQ = weighted displacement quotient.

low phi value suggests a direct benefit of the police operation in the target area). Given the small size of the target area it is highly likely that officers might have strayed into the buffer areas after exhausting their search of the target zone. This would easily be possible if officers were bored with a lack of evident crime in the target zone and were unsupervised for any period of time or undisciplined in maintaining their attention on a relatively small area of the city.

Comparisons before and after the operation show that police activity in the target area could be responsible for some of the significant 44 percent decrease in the crime types under scrutiny. A negative success measure and a negative buffer displacement measure (negative in a mathematical sense rather than the common implication of the word) are both indicative of positive crime outcomes. The values show that the police operation did have a crime reduction benefit to the target area when comparing before and after, and there was also a diffusion of benefits to the surrounding theoretically and practically derived displacement buffer zone. Improvements in both zones exceeded a more modest (but still welcome) reduction in the rest of the city. The WDQ value close to one leads to the conclusion that there was a diffusion of benefits into the buffer area about equal to the benefit of the operation within the target area. Overall, the target area saw substantial crime reductions that outperformed the remainder of the city by over five times.

Conclusion

The use of the WDQ has been shown to be of value beyond the initial application to burglary, as predicted by Bowers and Johnson (2003). Furthermore, with the inclusion of some relatively simple statistics it is possible to enhance the WDQ and increase the statistical robustness, which helps determine the suitability of the chosen buffer area. The addition of the phi statistic helps to ascertain that the buffer and target areas are functioning relatively independently of each other. In this way practitioners using the tool to examine police operations and crime prevention tactics are able to better address the possibility that any changes to the buffer area are not simply a corollary of changes in the target area but rather might be an independent reaction to the crime suppression operation. If there are noticeable changes to the buffer area, practitioners are frequently interested to know whether the buffer area changes were a response to the treatment. This interest is usually confined to an assumption of full displacement and rarely the more likely possibility of some diffusion of benefits. The phi statistic can inform this understanding by clarifying the relationship between target and displacement area and ruling out the possibility of spatial autocorrelation early in an analysis. If the phi value is low, it can be argued that the buffer area appears to be behaving largely independently of the target area. We can then use the WDQ to determine how much the treatment influenced the buffer area through displacement or diffusion and take this into account when assessing the value of the treatment.

Choosing a suitable buffer requires a nonstandardized approach with which many in the geographic analysis community might be unfamiliar. With specific regard to crime and human behavior, the interpretation of likely displacement zones is not just a facet of physical geography but also offender behavior in the light of changing opportunity structures and choices forced on the offenders by crime reduction tactics. Decisions about likely displacement locations have to be informed by a combination of theoretical grounding in the discipline of environmental criminology alongside a thorough local knowledge. The former is achieved through immersion in the scholarship of routine activity theory (Cohen and Felson 1979; Felson 1998), the rational choice perspective (Cornish and Clarke 1986; Clarke and Felson 1993), and crime pattern theory (Brantingham and Brantingham 1993a, 1993b). The latter is achieved through visiting crime-prone locations and the areas around crime prevention activity sites, ideally in the company of local residents or local police officers versed in the behavior of offenders. These requirements place a greater burden on analysts to define displacement areas that understand the nuances of local conditions, but the penalties for incorrect zoning or choosing a standardized buffer approach raise the possibility of either overestimating or underestimating the value of

the tactic being trialed. Although the WDQ is a simple enough tool, the geography that is associated with the tool is anything but.

Due to tendencies for communities not receiving the special attention of targeted enforcement to claim displacement, use of the WDQ allows law enforcement to address such concerns. If the results of the WDQ indicate a diffusion of benefits, this can be easily communicated to the community through media outlets to counter displacement arguments and show the success of a program. Indeed, there is considerable value in this alone; few communities or media representatives are aware of the existence of diffusion of benefits as a potential positive outcome from a targeted enforcement or prevention strategy. Conversely, enforcement can be expanded into buffer zones when the WDQ results suggest that crime might have moved into those areas. Either way, the WDQ—when combined with measures to indicate the relative independence of the buffer area—should become a valuable tool in the arsenal of police departments. ■

Note

[1] The phi statistic is the square root of the chi-square divided by N. A calculation similar to the phi calculation can be achieved by taking the square root of the Fisher's exact test. For situations where more than two areas are being examined, such as multiple buffers around a target area, Cramer's V might be suitable. Cramer's V is another chi-based statistic, with equation $V = \sqrt{\frac{x^2}{N(\min[(r-1,c-1)])}}$ where r = row and c = column. It can be interpreted similarly to phi.

Literature Cited

Barr, R., and K. Pease. 1990. Crime placement, displacement, and deflection. In *Crime and justice: An annual review of research*, ed. M. Tonry and N. Morris, vol. 12, 277–318. Chicago: University of Chicago Press.

Boba, R. 2005. *Crime analysis and crime mapping.* Thousand Oaks, CA: Sage.

Bowers, K., and S. D. Johnson. 2003. Measuring the geographical displacement and diffusion of benefit effects of crime prevention activity. *Journal of Quantitative Criminology* 19 (3): 275–301.

Brantingham, P. L., and P. J. Brantingham. 1993a. Environment, routine, and situation: Toward a pattern theory of crime. In *Routine activity and rational choice*, ed. R. V. Clarke and M. Felson, 259–94. New Brunswick, NJ: Transaction.

———. 1993b. Nodes, paths and edges: Considerations on the complexity of crime and the physical environment. *Environmental Psychology* 13:3–28.

Burgess, E. W. 1925. The growth of the city: An introduction to a research project. In *The city*, ed. R. E. Park, E. W. Burgess, and R. D. McKenzie, 47–62. Chicago: University of Chicago Press.

Chainey, S., and J. H. Ratcliffe. 2005. *GIS and crime mapping.* London: Wiley.

Clarke, R. V. 1995. Situational crime prevention. In *Crime and justice: A review of research*, ed. M. Tonry and D. Farrington, vol. 19, 91–150. Chicago: University of Chicago Press.

Clarke, R. V., and M. Felson. 1993. Introduction: Criminology, routine activity, and rational choice. In *Routine activity and rational choice*, ed. R.V. Clarke and M. Felson, 259–94. New Brunswick, NJ: Transaction.

Clarke, R. V., and D. Weisburd. 1994. Diffusion of crime control benefits. In *Crime prevention studies*, ed. R.V. Clarke, 165–83. Monsey, NY: Criminal Justice Press.

Cohen, L. E., and M. Felson. 1979. Social change and crime rate trends: A routine activity approach. *American Sociological Review* 44:588–608.

Cornish, D., and R. Clarke. 1986. *The reasoning criminal: Rational choice perspectives on offending.* New York: Springer-Verlag.

———. 1987. Understanding crime displacement: An application of rational choice theory. *Criminology* 25 (4): 933–47.

Eck, J. 1993. The threat of crime displacement. *Criminal Justice Abstracts* 25:527–46.

Felson, M. 1998. *Crime and everyday life: Impact and implications for society.* Thousand Oaks, CA: Pine Forge Press.

Fisher, R. A. 1922. On the interpretation of χ^2 from contingency tables, and the calculation of P. *Journal of the Royal Statistical Society* 85 (1): 87–94.

Green, L. 1995. Cleaning up drug hot spots in Oakland, California: The displacement and diffusion effects. *Justice Quarterly* 12 (4): 737–54.

Guerry, A.-M. 1833. *Essai sur la statistique morale de la France: precede d'un rapport a l'Academie de sciences [Essay on the moral statistics of France: Preceded by a report to the Academy of Sciences].* Paris: Chez Crochard.

Hakim, S., and G. Rengert. 1981. Introduction. In *Crime spillover*, ed. S. Hakim and G. Rengert, 7–19. Beverly Hills, CA: Sage.

Hesseling, R. 1994. *Displacement: A review of the empirical literature.* Monsey, NY: Criminal Justice Press.

Morgan, K. O. L., S. Morgan, and R. Boba. 2009. *City crime rankings 2009–2010.* Washington, DC: CQ Press.

Quetelet, A. 1842. *A treatise in man.* Edinburgh, UK: Chambers.

Ratcliffe, J. H. 2002. Burglary reduction and the myth of displacement. *Trends and Issues in Crime and Criminal Justice* 232:6.

———. 2005. Detecting spatial movement of intra-region crime patterns over time. *Journal of Quantitative Criminology* 21 (1): 103–23.

Ratcliffe, J. H., and T. Makkai. 2004. Diffusion of benefits: Evaluating a policing operation. *Trends and Issues in Crime and Criminal Justice* 278:1–6.

Reppetto, T. A. 1974. *Residential crime*. Cambridge, MA: Ballinger.

Shaw, C. R., and H. D. McKay. 1942. *Juvenile delinquency and urban areas.* Chicago: Chicago University Press.

Sherman, L. W. 1990. Police crackdowns: Initial and residual deterrence. In *Crime and justice: An annual review of research*, ed. M. Tonry and N. Morris, vol. 12, 1–48. Chicago: University of Chicago Press.

Tobler, W. 1993. *Non-isotropic modeling.* Santa Barbara, CA: National Center for Geographic Information and Analysis.

Weisburd, D., L. Wyckoff, J. Ready, J. Eck, J. Hinkle, and F. Gajewski. 2006. Does crime just move around the corner? A controlled study of spatial displacement and diffusion of crime control benefits. *Criminology* 44:549–91.

Yang, D. 2008. Can enforcement backfire? Crime displacement in the context of customs reform in the Philippines. *Review of Economics and Statistics* 90 (1): 1–14.

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