Kansas City's Violent Crime Initiative: A Place-Based Evaluation of Location-Specific Intervention Activities During a Fixed Time Period

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Abstract

A place-based method of evaluation and spatial units of analysis were used to measure the extent to which Kansas City, Missouri's Violent Crime Initiative (VCI) affected the post-intervention frequency and spatial distribution of crime events at micro-level places. Analytical strategies directly addressed the place-based nature of the VCI activities and were sensitive enough to assess the impact of the VCI without results being confounded by aggregation effects coming from the ecological fallacy. Risk terrain modeling methods were used to operationalize Kansas City's contextual criminogenic landscape. Results suggest that the spatial dynamics of aggravated assaults did not change in Kansas City over a climatically stable six month time period, despite activities of the VCI midway. The presence of environmental risk factors and past aggravated assaults affected the locations of new incidents, so pre- and post-VCI incidents tended to occur where they always did, in contextually similar types of places. The analysis demonstrates ways in which spatial analysis techniques can complement traditional "aggregate crime drop" evaluations of a targeted intervention's success or failure by taking into account micro-level place-based effects.

INTRODUCTION

The quasi-experimental study presented here evaluates the impact of a Violent Crime Initiative (VCI)—a location-specific and time-limited intervention carried out by the Kansas City (MO) Police Department and its partner agencies during the summer of 2010. This study utilized a place-based method of evaluation and spatial units of analysis to measure the extent to which the VCI affected the post-intervention frequency and spatial distribution of crime events at micro-level places. The series of analyses begins with KCPD's own internal, aggregate, measures of crime rate declines in the target areas. We evaluated whether effects of the VCI were measurable at all micro-level places within the target areas. That is, were KCPD's publically-proclaimed aggregate effects of the VCI generally felt throughout all micro-places within the target areas? Then we assessed the extent to which the VCI affected the spatial distribution of post-intervention crimes. This part of the study sheds light on the spatial nature and locations of crimes in Kansas City within the context of the VCI, as well as, criminogenic environments, past crime events, and hotspot areas. The overall analysis demonstrates ways in which spatial analysis techniques can improve upon traditional "raw count" evaluations of a targeted intervention's success or failure by taking into account micro-level place-based effects—following the analytical strategy advocated by Weisburd, Bernasco and Bruinsma (2008) and Weisburd, Groff and Yang (forthcoming).

There is a long history of systematic evaluations of interventions in policing, dating back at least to the original Kansas City Preventive Patrol Experiment (Kelling, et al., 1974) and the Newark Foot Patrol Study (Kelling, 1981). Much research has revolved around the identification of specific problem areas and, in the work that has been done on evidence-based evaluation, comparing these locations to similar areas that did not receive a targeted intervention or treatment[1]. There has also been research and discussions about features of environments that enhance the likelihood of crime outcomes (e.g., Caplan, Kennedy, & Miller, 2010; Kennedy, Caplan, & Piza, 2011; Groff & La Vigne, 2002; Andresen & Malleson, 2011). This work has had the effect of increasing police interests in predictive analysis and strategic proactive responses to a variety of crime problems using an intelligence-led approach (Murray, 2012).

Intelligence-led policing is a central paradigm for Kansas City and other police agencies seeking to incorporate information sources into decision-making and operational practices (Weisburd, Mastrofski, McNally, & Greenspan, 2001). Intelligence is a constant process of data collection, analysis, distribution, and assessment. Ratcliffe (2003) explains the integration of the intelligence model in policing as "…the application of criminal intelligence analysis as an objective decision-making tool in order to facilitate crime reduction and prevention through

[1]Lum, Koper, & Telep (2011) present an exhaustive review of these evaluations within what they refer to as an evidence-based policing matrix.

effective policing strategies and external partnership projects drawn from an evidential base" (p. 3). The approach suggests that an informed police agency will perform in a more effective and efficient way. According to Ratcliffe, three components contribute to this form of policing and, ultimately, crime prevention: the interpretation of intelligence, the influence that this has on decision-makers, and the ultimate impact that this has on the criminal environment. If intelligence is simply used as a reactive tool, confirming decisions that have already been made and resources already allocated, then it will not be very useful. If intelligence is applied to prospective decision-making, that is, when decisions are made on the basis of anticipated demands and clear priorities, then the efficacy of intelligence information is greatly enhanced (McGarrell et al., 2007). But the information or intelligence funneled to police commanders and patrol officers needs to be framed in a way that allows them to use it to make practical sense of their environments. This evaluation of the Kansas City VCI was conducted with this principle in mind—to produce meaningful and actionable information for the comprehensive assessment of past events and to plan new activities.

In finding a way to implement intelligence-led policing, criminal justice experts and police scholars have examined the merits of looking at policing from the point of view of risk, and taking the frameworks used in applying information derived from risk analysis to decision-making through a process of evaluation and priority setting (Kennedy & Van Brunschot, 2010; Kennedy & McGarrell, 2011). Criminogenic risk is defined by Kennedy and Van Brunschot (2009) as "a consideration of the probabilities of particular outcomes" (p. 4). Risk-based approaches overcome the limitations of a reactive orientation in favor of a more proactive one by drawing attention to the hazards and dangers that threaten the communities that are policed. Through the combined efforts of risk assessment and risk governance, police leaders and stakeholders are afforded a more systematic approach to managing and altering their environments (Kennedy & McGarrell, 2011). The study reported on here was designed so that results of micro-level spatial analyses could be incorporated into KCPD's existing risk-based and intelligence-led policing paradigm, and so that new insights could inform reforms to future crime suppression and prevention initiatives.

We present an overview of the setting and background of the violent crime initiative. Then we offer a review of the relevant literature focusing on risk-based policing, crime concentration, and police interventions and related assessments. Then, we incorporate the insights drawn from the literature review into the 'Methods' and 'Results' sections that follow. Results are presented in two parts: 1) a crime count analysis assesses the extent to which the VCI affected the frequency of crime at micro-level places throughout the target areas; and 2) a contextual analysis assesses the extent to which the VCI affected the spatial nature of crime incident locations at the micro-level. A specific and generalizable discussion of the results concludes the paper.

SETTING AND BACKGROUND OF THE VIOLENT CRIME INITIATIVE

Kansas City is the largest city in the state of Missouri with an estimated population of 459,787 in 2010 (U.S. Census Bureau, 2012). The City encompasses approximately 318 square miles, spanning Jackson, Cass, Clay, and Platte counties. The Kansas City Missouri Police Department (KCPD) is the agency tasked with protecting life and property while reducing fear and disorder. The Board of Police Commissioners governs more than 1,400 officers and 600 civilians (KCPD, n.d.).

Every year since 2008, the KCPD Violent Crimes Division and the Narcotics and Vice Division has spearhead a violent crimes initiative (VCI) in collaboration with other law enforcement agencies[2] (Forte, 2010). Activities for the initiative—the focus of this study—occurred between July 28 and 29, 2010 and focused on five of the most crime-ridden areas of Kansas City. These were selected based on (kernel density) hotspots of known recent-past homicides, drive-by shootings, aggravated assaults, drug activity, and other police calls for service that were violent in nature. The VCI's target areas ultimately comprised three percent of Kansas City's land area, but were host to 27 percent of its homicides, 41 percent of its drive-by shootings and 30 percent of its aggravated assaults from January to June 2010.

Activities of the VCI (i.e., also referred to as the intervention) involved law enforcement officers serving search warrants and conducting buy-busts and knock-and-talks[3] within the target areas; these activities occurred mostly during daylight hours. More than 150 officers also went door-to-door in many neighborhoods throughout Kansas City to gather and solicit information about five unsolved homicide cases. The general goals of the VCI were to mitigate existing violent crime problems by closing unsolved criminal cases, to deter new violent crimes by way of increased police presence, and to incapacitate known offenders through arrest and swift prosecution. Robberies, narcotics, and weapon offenses were of concern to KCPD officials, but aggravated assaults received priority.

We evaluate the micro place-based effects of the VCI on the frequencies of these four crime types, and then conduct a more detailed spatial contextual analysis only on the priority crime of aggravated assault. Aggravated assault is defined as "an unlawful attack by one person upon another wherein the offender uses a weapon or

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[2]Collaborators include the Independence Police Department; Federal Bureau of Investigation; Bureau of Alcohol, Tobacco, Firearms and Explosives; Immigration and Customs Enforcement; U.S. Marshals Service; United States Postal Inspection Service; Drug Enforcement Administration; Internal Revenue Service; Jackson County Prosecutor's and U.S. Attorney's offices; and the Clay County Sheriff's Department.

[3]A Knock & Talk is an investigative technique when investigators respond to a location and talk to occupants in hopes of gaining useful information about a crime and/or consent to search that location to locate contraband or wanted subjects when a warrant has not yet been obtained.

displays it in a threatening manner, or the victim suffers obvious severe or aggravated bodily injury involving apparent broken bones, loss of teeth, possible internal injury, severe laceration, or loss of consciousness," and, for this study, excluded incidents noted as domestic violence (to produce a more reliable measure of "street" crime)[4].

Crime data were provided by the KCPD[5] and included only substantiated incidents that were recorded and investigated by the department. To ensure data integrity and reliability, all crime data were acquired through a direct ODBC connection to the KCPD's Tiburon Automated Reporting System (ARS) database, its central location of reported offense data. KCPD officials publically reported aggregate level effects of the VCI based on comparisons between 90-day time periods before and after the intervention period (Baughman, 2011). Pre/post crime counts for incidents within all five target areas are as follows: 136/116 for aggravated assault (-14.7%), 66/59 for robberies (-10.6%), 32/46 for weapon possession (+43.7%), and 208/263 for narcotics offenses (+26.4%). Pre-to-post intervention increases for weapon and narcotics offenses were explained by KCPD officials as resulting directly from enforcement activities and, therefore, a positive outcome indicative of success (Baughman, 2011). In addition to these statistics, several other measures of success were attributed to the VCI by KCPD officials during the two day initiative: there were 120 warrants cleared; 17 search warrants served; 74 arrests made; $48,706 in U.S. currency recovered; 76 grams of cocaine, 32,135 grams of marijuana, 33 grams of methamphetamine, 56 grams of heroin, and 7,257 grams of PCP confiscated; and 15 handguns, 4 shotguns, and 4 rifles seized (Kansas City Missouri Police Department, 2010a). In the context of violent crimes, which run a high risk of serious injury or death, these aggregate figures reported by KCPD officials were viewed as a meaningful and significant dividend of the VCI. However, the micro place-based effects of the intervention were not evident as the VCI's impacts on the spatial distribution of crime at micro-level places within the target areas or throughout Kansas City were not evaluated by KCPD analysts.

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[4]Robbery in Kansas City is defined as "the taking or attempting to take anything of value under confrontational circumstances from the control, custody, or care of another person by force or threat of force or violence and/or by putting the victim in fear of immediate harm." Weapons offenses included the violation of laws or ordinances prohibiting the manufacture, sale, purchase, transportation, possession, concealment, or use of firearms, cutting instruments, explosives, incendiary devices, or other deadly weapons. Narcotics offenses included the violation of laws prohibiting the production, distribution, and/or use of certain controlled substances and the equipment or devices utilized in their preparation and/or use; this commonly included offenses such as Possession of a Controlled Substance and Possession of Drug Paraphernalia.

[5]Crime data was delivered in shapefile format and was not limited only to address-level geocoded points, but also included incidents located elsewhere throughout the jurisdiction. The quality of the data, then, permitted us to assume that crime (i.e., point features) could technically occur anywhere throughout the Kansas City landscape. Therefore, all micro-places were included in the analyses—not only those that intersected with streets.

The key aim of this study is to measure the effects of the VCI on the spatial distribution of aggravated assaults at the micro-level. In this way, the evaluation strategy directly addresses the place-based nature of the VCI activities and is sensitive enough to assess the impact of the VCI without results being confounded by aggregation effects coming from the ecological fallacy (Robinson, 1950). The ecological fallacy refers to an error in the interpretation of results whereby assumptions about the VCI's success or failure are based solely upon aggregate statistics for the targeted areas. To state that every micro-level place within the target areas did or did not have a reduction in aggravated assaults based upon aggregate data may not be accurate. Rather, local variations in crime concentrations and, presumably, criminogenic characteristics of these locales can differentially impact the ability of the VCI to deter crimes. Knowing that certain features of the environment can attract and enable different types of violent crimes above-and-beyond the routine activities of offenders, victims, or police (Andresen, 2006), Kansas City's environmental landscape must be considered when evaluating geographically targeted interventions. Basically, VCI activities may not have similar benefits everywhere and, therefore, should be evaluated at the micro-place level. The effects on crime, then, are not measured only in the aggregate across all contextually unique micro places within the target areas.

REVIEW OF RELATED LITERATURE

High or low risk is often attributed to conventional offender-based risk assessments, first established many decades ago when researchers began to demonstrate that certain characteristics of offenders were correlated with their subsequent behavior (Burgess, 1928; Glueck & Glueck, 1950; Miller & Lin, 2007). Offender characteristics are scored and combined to form a scale that is indicative of "risk"—such as the risk of re-arrest or reconviction, the risk of absconding while on bail, or the risk of violating conditions of parole or probation (Clear, Wasson, & Rowland, 1988; Gottfredson & Gottfredson, 1979, 1984; Gottfredson & Moriarty, 2006). Turning attention away from the offender and on to the place where crime occurs, the attractiveness of risk-based approaches to policing is that risk assessment can tie information closely to both strategic and tactical decision-making, providing a means by which police leadership can evaluate success of interventions and plot future actions. It comports with the idea that the public has anxieties that translate into demands for prevention strategies to reduce criminogenic risk, and it addresses the idea that certain areas can be more dangerous than others and, therefore, demand greater police attention (Braga & Weisburd, 2011). Risk assessment can articulate evaluation plans used to determine the effectiveness of interventions and the efficacy of certain types of resource allocation decisions (McGarrell et al., 2007). So, risk assessment can be an attractive framework for policing that takes advantage of new information and intelligence, while involving a more aware and sophisticated police

force more directly in a dialogue with the public about safety and security issues (Kennedy & McGarrell, 2011; John & McGuire, 2003).

In the adoption of risk-based approaches to policing and research there has been a great deal of attention brought to bear on why crime concentrates and how places that are subject to high levels of crime can provide opportunities for targeted interventions. In research done within Irvington (Caplan et al., 2010) and Newark, New Jersey, (Kennedy et al., 2011), there is evidence that a clustering of social and physical risk in certain areas significantly increases the probability for crime and enhances the accuracy of forecasts about crime incident locations. These strong relationships were robust over time and actually outperformed predictions using conventional hotspot analysis techniques. Based on these findings, the investigators recommended that police agencies adopt a strategy of using crime correlates as a means by which to identify highly vulnerable areas that could be justifiably suitable for targeted interventions—and to evaluate such interventions accordingly. The nature of risk-based interventions would have to be carefully considered: police would want to reduce actual crime incidents with a focus on likely offenders and potential victims, but also to change the deleterious effects of the risk factors on the landscape of the vulnerable environments. In addition to a simple measure of aggregate change (i.e., drop or increase) in reported crime incidents within the target area, Caplan and Kennedy (2010) explained that the context of micro-level risky places could be incorporated into an evaluation of the impact of police interventions at these areas. Aligned with this approach, Weisburd (2008) advocates the importance of place-based solutions to crime, while acknowledging that the major impediment to this has been the lack of good place-based data to use for identifying and responding to problem areas.

In a systematic review of intervention studies, Braga & Weisburd (2011) suggest that, overall, place-based approaches are effective at reducing crime. They state that with regard to environmental criminology, the important change to interventions has been the shift from person to location. “The attributes of a place are key in explaining clusters of criminal events” (5), Braga and Weisburd explain. Most studies in their meta-analysis were focused on treatment effects in areas of high crime concentration. In a majority of these studies, the places defined as hotspots were successfully impacted by police intervention through drops in crime. The criterion for inclusion in the meta-analysis was that the intervention involved a police enforcement action, including directed patrol, and that the intervention be place-based. The impact of the intervention was measured as the mean difference in crime outcomes before and after the interventions. In looking at the results of these interventions, Braga and Weisburd report that almost all of the studies reported significant reductions of crime incidents, but mixed effects in terms of lowering calls for service for disorder, property, and violence offenses. They concluded that intervention at hotspots (i.e., as KCPD did with the VCI) using police enforcement

techniques generally works; but, there needs to be more attention paid to the nature of the interventions and the situational context of the areas being targeted.

A recent noteworthy addition to intervention projects is the Philadelphia foot patrol study that, although not strictly a targeted enforcement activity, was a place-based approach based on a methodology that used hotspots to select treatment areas. Ratcliffe, Taniguchi, Groff, and Wood (2011) pre-selected target areas for patrol based on criminal history and then randomly assigned comparable areas as controls. They then allocated new recruits from police classes to foot patrols in the treatment areas. The researchers found that foot patrols had a significant impact on crime occurrence in the hotspot areas (defined in terms of crime reporting). After assessing the effects of the treatment from conventional patrol, Ratcliffe et al. (2011) concluded:

> We found that violent crime hotspots that were recipients of foot patrol officers for up to 90 hours per week had a reduction in violence of 90 offenses (with a net effect of 53 offenses once displacement is considered), outperforming equivalent control areas by 23%. However, the benefits were only achieved in areas with a threshold level of pre-intervention violence. When that threshold was achieved (in our study an average of 6 violent crimes in the three months pre-intervention), these target areas in the top 40% on pre-treatment violent crime counts had significantly lower levels of violent crime during the operational period, even after accounting for natural regression to the mean (p. 818).

So, place-based interventions can be effective, but the effects tend to be most strongly felt at places with higher levels of pre-intervention crimes.

The Philadelphia experiment and Braga's excellent review of police intervention strategies underscore the long standing desires to focus police attention on places as well as people, and provide support that such as strategy should work. Braga and Ratcliffe et al. point out that there are unanswered questions that emerge from place-based intervention research relating to scale of areas covered, intervention strategies, and dosage effects. But, as we discussed above, we would add that relying on the measure of an aggregate drop in crime within the target areas from pre- to post-intervention does not account for the differential spatial effects of the intervention activities at micro-level places throughout the target areas. This forms the central focus of the research reported below.

METHODS AND CONCEPTUAL FRAMEWORK

This study focuses on the impact of the VCI based on the counts and spatial distributions of crimes at micro-level places within the target areas and throughout the greater Kansas City landscape. Raster mapping in GIS was specifically developed

to model continuous landscapes (Tomlin, 1994; Tomlin, 1991) and captures the reality of how people operate within a landscape. It is very good for modeling how crime can occur at micro-level places (Groff & La Vigne, 2002; Caplan, Kennedy, & Miller, 2011). Crime analysts in Kansas City use vector and raster techniques to map crime as it occurs throughout the city. In fact, the VCI's target areas were determined by drawing polygons around clusters of contiguous raster cells with similar (high) crime density values. That is, areas within which violent crime hotspots existed.

The principally-targeted crime of aggravated assaults could conceivably occur at any location in Kansas City. Criminals do not generally offend with regard to census tract, target area, or other geographic units of aggregation. As Caplan (2011) explains, "A victim who was shot at 123 Main Street could just as likely been shot at 115 Main Street if he stopped to tie his shoe, walked slower, or was delayed for any number of other reasons" (p. 71). To model such a continuous crime opportunity surface (Groff & LaVigne, 2002) for this study, raster cells were the standard unit of analysis for statistical testing. A grid of the entire jurisdiction of Kansas City was comprised of 142,221 cells of 250ft x 250ft. Consistent with the work of Weisburd et al. (2009) and others (e.g., Caplan, 2011; Caplan et al., 2011; Kennedy et al., 2011), the cell size was selected as a function of street segments: approximately half the mean block length in Kansas City (mean=470ft). This allowed us to model micro places for crime occurrence as precisely as one corner of a street block, and is likely to be the smallest spatial unit to which police could reasonably be deployed.

About nine square miles (251,375,000 ft^2), or 4,022 cells, intersect with the VCI's five separate target areas, as displayed in Figure 1. Data were attached to each cell to serve as independent, dependent and control variables for inferential statistical analyses[6]. Operational definitions for crime data were already discussed (see Footnote 4); the remaining data variables are discussed in detail (below) within the context of the analytical procedures that utilized them. Esri's ArcGIS with the Spatial Analyst Extension was used for data mapping and spatial analyses. Some procedures were completed with tools in the RTM Toolbox for ArcGIS 10 (downloaded for free at http://www.rutgerscps.org/rtm). The "pre-VCI" time period refers to April 28 through July 27, 2010; the "post-VCI" time period refers to July 30 through October 29, 2010.

MICRO-LEVEL CRIME COUNT METHODS

Statistical significance of changes in the frequencies of aggravated assaults, robberies, narcotics, and weapon offenses (respectively) at micro-level places within the target areas for up to 90 days after the intervention were assessed with paired samples t-tests. Then, to determine the extent to which VCI activities affected the

[6]Raster layers can only have one data variable attributed to them in ArcGIS. So, the raster layer was converted to a vector grid of cells for these purposes.

key crime of aggravated assaults in the target areas compared to elsewhere in Kansas City, 4,022 cells from outside the target areas were randomly selected (the same number of cells as located within the target areas). Micro-level places within the target areas were found to have fared slightly better compared to other places in Kansas City[7], which suggested displacement. But a Weighted Displacement Quotient[8] of 0.389 suggested that displacement of aggravated assaults from the target area did not occur (Ratcliffe & Breen, 2008; Clarke & Eck, 2005; Bowers & Johnson, 2003). It is difficult to know with certainty (i.e., regardless of the statistics used) if aggravated assaults were displaced outside of the target areas because it is nearly impossible to associate the occurrence of new crime incidents with the absence of where they would have occurred otherwise. So rather than concluding that displacement or diffusion happened, the spatial nature of aggravated assaults in Kansas City, pre- and post-VCI, was assessed with a 2x2 cross tabulation table and Chi-Square test. All micro places (i.e., raster cells) were designated as located within pre-VCI hotspots if their kernel density[9] values were greater than +2 standard deviations from the mean density value of pre-VCI aggravated assaults. The presence/absence of post-VCI aggravated assaults within each cell was used as the second variable.

This component of the study addresses whether crime reduction effects of the VCI (as originally reported by KCPD officials) were statistically significant and generally achieved throughout all micro-level places within the target areas. Exploration of the spatial distribution of post-VCI aggravated assaults provides the foundation upon which a more detailed analysis and explanation of the spatial-contextual dynamics of aggravated assaults is built (as discussed in the next section).

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[7]According to a paired samples t-test, the average number of aggravated assaults in the randomly selected (and not VCI-targeted) cells significantly increased post intervention (n=4,022; pre-VCI mean=0.00, SD=0.039; post-VCI mean=0.01, SD=0.092; $p < 0.01$).

[8]Calculated using SEPTIC (Ratcliffe & Breen, 2008). SEPTIC requires six input values: pre/post crime counts within the target area, pre/post crime counts within the buffer area, and pre/post crime counts within the control area. The target area was the VCI target area. The buffer area was a 1,410ft buffer outside the target area. This distance equals about three average blocks and was selected based on similarly justified research by Weisburd and Green (1995). The control area was all of Kansas City, except the target or buffer areas.

[9]Kernel density calculations were performed in ArcGIS 10. Consistent with the work of Weisburd et al. (2009) and others (e.g., Caplan et al., 2011; Kennedy et al., 2011), the cell size was selected as a function of street segments: about half the mean block length in Kansas City, or 250ft. A search radius (bandwidth) of 1,410ft was selected based upon empirical research suggesting that behavior settings, which are "regularly occurring, temporally and spatially bounded person-environment units", typically comprise up to just a few street blocks (Taylor, 1988; Taylor & Harrell, 1996).

MICRO-LEVEL CONTEXTUAL METHODS

Certain criminogenic features of the Kansas City landscape may attract and enable aggravated assaults above-and-beyond the activities of victims, offenders, and the police (Caplan et al., 2010; Kennedy et al., 2011; Caplan, 2011; Shaw & McKay, 1969; Cohen & Felson, 1979). This could explain the persistence of hotspots and repeat aggravated assaults at certain locations despite the two-day Violent Crime Initiative (VCI) and abundance of dedicated resources. The VCI target areas were defined by existing (pre-VCI) hotspots of aggravated assaults and other violent crimes. If certain environmental conditions made these places attractive to motivated offenders and were not mitigated, then it means that the VCI would not have a lasting and significant effect on the post hoc spatial distributions of aggravated assaults. The VCI was a short-term operation that focused primarily on specific deterrence and incapacitation of people within the target areas; it did not include a concerted effort to mitigate environmental factors that are known to correlate with aggravated assaults. Research suggests that persistent crime can be explained by the routine presence of motivated offenders and unmitigated environmental factors that attract and enable the occurrence and recurrence of crime (Cohen & Felson, 1979; Cohen, Kluegel, & Land, 1981). Cohen and Felson (1979, p. 595), for example, explained that while crime can be more easily facilitated if there are motivated offenders, suitable targets for victimization, and an absence of capable guardians, "the risk of criminal victimization varies dramatically among the circumstances and locations in which people place themselves and their property". If uniquely criminogenic contexts for aggravated assaults existed in Kansas City, then they probably persisted throughout the study period. These 'comfort zones' for motivated offenders remained attractive illegal behavior settings (Felson, 1995; Taylor & Harrell, 1996) even after the VCI ended. Based upon this explanation, it is hypothesized that: 1) Aggravated assaults, both before and after the VCI, were likely to occur at micro places most suitable for such crimes given the co-existence of certain environmental risk factors at those places, and 2) The locations of aggravated assaults post-VCI can be explained by the co-existence of environmental risks and pre-VCI hotspots at micro places. To test these assumptions, we used risk terrain modeling methods to operationalize Kansas City's contextual criminogenic landscape and to investigate further why the VCI had only negligible effects on the spatial distribution of aggravated assaults over the long term.

Risk terrain modeling, or RTM, is an approach to spatial analysis that utilizes a geographic information system to operationalize the spatial influence of risk factors to common geographic units. Separate risk map layers are combined to produce a "risk terrain" map showing the presence, absence, or intensity of all risk factors at every location throughout the landscape (Caplan & Kennedy, 2010). Caplan, Kennedy & Miller (2010), Kennedy, Caplan & Piza (2011), Caplan (2011) and others (e.g., Gale & Holleran, 2011; Bocker & Rusnak, 2011; Gaziarifoglu & Kennedy, 2011; Heffner & Cheetham, 2011; Kim & Holleran, 2011; Fox & Holleran,

2011; Powell & Holleran, 2011; Rollerson, 2011; Edmonds & Mallard, 2011; Hill, 2011) have demonstrated how theoretically- and empirically-grounded risk terrain maps can articulate micro-level places where conditions are suitable for crimes to occur given existing environmental contexts. Clustering of illegal activity in particular areas is explained in a risk terrain model by the unique combination of risk factors that make these areas opportune locations for crime. This occurs where the potential for, or risk of, crime comes as a result of all the factors found at these places (Caplan, 2011). RTM offers a statistically valid way to articulate, study, and display criminogenically vulnerable areas at the micro-level and, thus, we used it to guide the spatial-contextual component of this evaluation study.

A risk terrain model was created for aggravated assaults in Kansas City in accordance to the steps described by Caplan and Kennedy (2010). Eleven measures of risk factors of aggravated assaults were identified based on existing empirical research: bars (Scott & Dedel, 2006), hotels/motels (Madensen & Eck, 2008), packaged liquor stores (Scott & Dedel, 2006; Maguire, 2007; Hunter & Jeffery, 1997), movie theaters (Madensen & Eck, 2008; Maguire, 2007), grade schools (Madensen & Eck, 2008; Roncek et al., 1985; Maguire, 2007), drug activity (Office of National Drug Control Policy, 2000; Rand, 2008; Rengert, Ratcliffe, & Chakravorty, 2005; Stucky & Ottensmann, 2009), rental halls (Madensen & Eck, 2008), parks (Madensen & Eck, 2008), adult entertainment clubs (Madensen & Eck, 2008; Scott & Dedel, 2006; Truman & Rand, 2010), dance/night clubs (Madensen & Eck, 2008; Scott & Dedel, 2006; Rand, 2008), and franchised fast food restaurants (Madensen & Eck, 2008; Scott & Dedel, 2006; Brantingham & Brantingham, 1995; Block & Block, 1995; Clarke & Eck, 2005; Eck et al., 2007; Kennedy, Caplan & Piza, 2010). Latitude and longitude coordinates for bars, adult entertainment clubs, hotels/motels, dance/night clubs, franchised fast food restaurants, rental halls, and movie theaters were obtained from InfoGroup, a leading commercial provider of business and residential information for reference, research, and marketing purposes[10] (InfoGroup, 2010). Shapefiles for packaged liquor stores, grade schools, drug activity, and parks were obtained from the Kansas City Police Department (KCPD), along with point-level crime data for 90 days before and after the VCI dates. All risk factor features were located in Kansas City[11].

[10]InfoGroup compiles and verifies data from multiple sources, including Yellow and White Page directories, county level public sources, real estate data, press releases, news feeds, postal processing, and beyond.

[11]Bars included all businesses with a North American Industry Classification System (NAICS) code of "Drinking Places Alcoholic Beverages" and categorized as "Bars." Adult entertainment clubs included all businesses with a NAICS code of "Independent Artists Writers & Performers" and categorized as "Entertainers-Adult." Hotels/motels included all businesses with a NAICS code of "Hotels & Motels Except Casino Hotels" and categorized as "Hotels & Motels." Dance/night clubs included all businesses with a NAICS code of "Drinking Places Alcoholic Beverages" and categorized as "Night Clubs." Franchised fast food restaurants included all businesses with a NAICS code of "Full-Service Restaurants", categorized as "Restaurants," and noted as being part

Risk factor data were operationalized to separate binary-valued risk map layers as a function of either density or distance. Bars, hotels/motels, and reported drug activity were operationalized as kernel density maps (cell size=250ft; bandwidth=1,410ft) because their spatial influence was understood as "areas with greater concentrations of these features, respectively, will increase the risk of those places having aggravated assaults" (Caplan, 2011). All 250ft cells (i.e., micro places) with density values greater than +2 standard deviations from the mean density value was considered "highest risk" and assigned a value of "1"; all other places were considered "not highest risk" and assigned a value of "0." Packaged liquor stores, movie theaters, grade schools, rental halls, parks, adult entertainment clubs, dance/night clubs, and franchised fast food restaurants were operationalized as Euclidian distance maps; their spatial influence was understood as up to 1,410ft from these features are at greatest risk for aggravated assaults because targeted victims are most vulnerable when they arrive at or leave these destinations. Cells that were located within 1,410ft of each set of features were considered "highest risk" places, respectively, and given a value of "1"; all other cells were considered "not highest risk" places and given a value of "0". The value of 1,410ft for density and distance parameters was informed by empirical research suggesting that crime-prone places typically comprise just a few street blocks, which qualify as behavior settings (e.g., Felson, 1995; Taylor & Harrell, 1996) that are "regularly occurring, temporally and spatially bounded person-environment units" (Taylor, 1988). The mean block length in Kansas City is 470ft. Two other attributes were also assigned to each cell noting the presence ("1") or absence ("0") of any pre- or post-VCI aggravated assault incidents.

Every risk map layer was tested for place-based correlations with pre-VCI aggravated assault incident locations using 2x2 cross tabulation tables and Chi-Square tests—in accordance with the tutorial provided online by the Rutgers Center on Public Security (2011, p. 3), and as done by Kennedy, Caplan, and Piza (2011) in Newark, NJ. Risk map layers that had significant Pearson Chi-Square values at $p < 0.001$ and that had "highest risk places" accounting for more than 20% of places with aggravated assaults were included in the risk terrain model. Table 1 presents results of tests for each risk map layer.

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of a franchise (e.g., McDonald's, Burger King, Subway). Rental halls included all buildings registered with a NAICS code of "Fitness &Recreational Sports Centers" and categorized as "Halls & Auditoriums." Movie theaters included all businesses with a NAICS code of "Motion Picture Theaters, Except Drive-Ins" and categorized as "Theatres-Movie." Packaged liquor stores included all businesses with liquor licenses that permit the sale of packaged alcoholic beverages. Grade schools included point-level data of the main addresses for public and private K-12 schools. Point-level drug activity data was obtained from KCPD's DRAGNET database, which includes all founded and unfounded citizen or officer reports of narcotics-related activity. The KCPD considers DRAGNET data to be a good (proxy) measure of drug markets in Kansas City—and a better measure of drug activity than drug arrests. Park locations were obtained from KCPD as a polygon shapefile; only "types" listed in City records as "Neighborhood" parks were included.

Table 1. Chi-square results for risk map layer validity

Risk factor	Pct. of cells with any aggravated assaults located within highest risk places (n=397)	Pearson Chi-Square value	df	Sig.
Bars	12.8	61.73	1	<0.001
Hotel/Motel	6.8	12.08	1	<0.010
Package Liquor	**50.1**	343.74	1	<0.001
Movie Theater	4.0	23.91	1	<0.001
Grade School	**32.7**	88.40	1	<0.001
Drug Activity	**54.2**	606.34	1	<0.001
Rental Halls	8.8	74.49	1	<0.001
Parks	**37.0**	77.78	1	<0.001
Adult Entertainment	2.3	19.93	1	<0.001
Dance/Night Club	5.8	27.99	1	<0.001
Franchised Fast Food	**20.2**	103.91	1	<0.001

Packaged liquor stores, grade schools, drug activity, parks, and franchised fast food restaurants were selected for inclusion in the risk terrain model. Weights for these five risk map layers were calculated based on each risk factor's relative spatial influence on the locations of pre-VCI aggravated assaults—in accordance with the tutorial provided online by the Rutgers Center on Public Security (2011, p. 2). The general form of the calculation for relative spatial influence (RSI) is presented in Equation (1):

$$RSI_j = O_{i,t,j} \div C_j \qquad (1)$$

Where, RSI_j is the Relative Spatial Influence value for risk map layer j
$O_{i,t,j}$ is the number of outcome events i that occurred during time period t and that were located within the highest-risk cells of risk map layer j
C_j is the number of cells designated as highest-risk for risk map layer j.

As shown in Table 2, weights were calculated for each risk map layer by dividing the RSI value for each risk map layer by the smallest RSI value (among all risk map layers). Risk map layers were combined with their respective weights using the "Weighted Sum" tool in ArcMap to produce the final risk terrain map shown in Figure 1.

Table 2. Inter-risk map layer weights

Risk Map Layer (*j*)	Pre-VCI aggravated assaults located in highest risk places ($O_{i,t}$)	Highest risk cells (C_j)	Relative spatial influence (RSI)	Risk map layer's weight
Package Liquor	221	15,599	0.0141	1.76
Grade School	144	14,961	0.0096	1.20
Drug Activity	233	9,097	0.0256	3.20
Parks	162	20,142	0.0080	1.00
Fast Food	92	7,563	0.0121	1.51

To-date, prior studies using micro-places and risk terrain modeling methods have used binary logistic regression to test for predictive validity (i.e., Caplan et al., 2011a, 2011b; Kennedy et al., 2011). However, given that multiple crime events may cluster at particular micro-places in Kansas City, the use of binary logistic regression may undercount the total number of pre- and post-VCI crimes if multiple incidents are classified as a single unit to fulfill the (binary) requirements of running logistic regressions. This is even despite the fact that there is a high frequency of micro places *without* any reported crimes (99.7%) and low frequency of cells *with* more than one incident (<0.03%; N=142,221; Range=0 to 5)—a consequence of the small 250ft unit of analysis. Recognizing this issue, and because the dependent variables are count-based non-negative accounts of crimes, negative binomial regression models were used as they do not assume an equal mean and variance and, in particular, correct for over-dispersion in the data (Osgood, 2000; Paternoster & Brame, 1997). In light of the high frequency of cells with *zero* incidents, negative binomial regression is considered an appropriate approach for this study—and an advance on prior related research. It should be noted, however, that logistic regression analyses were also run for each model in order to compare the results of each type of analysis and that the results from both regression analyses yielded similar (significant and positive) results. Though, only negative binomial results will be presented.

We completed the study with an assessment of the impact of the VCI in the target areas while controlling for environmental context and past crime counts at the

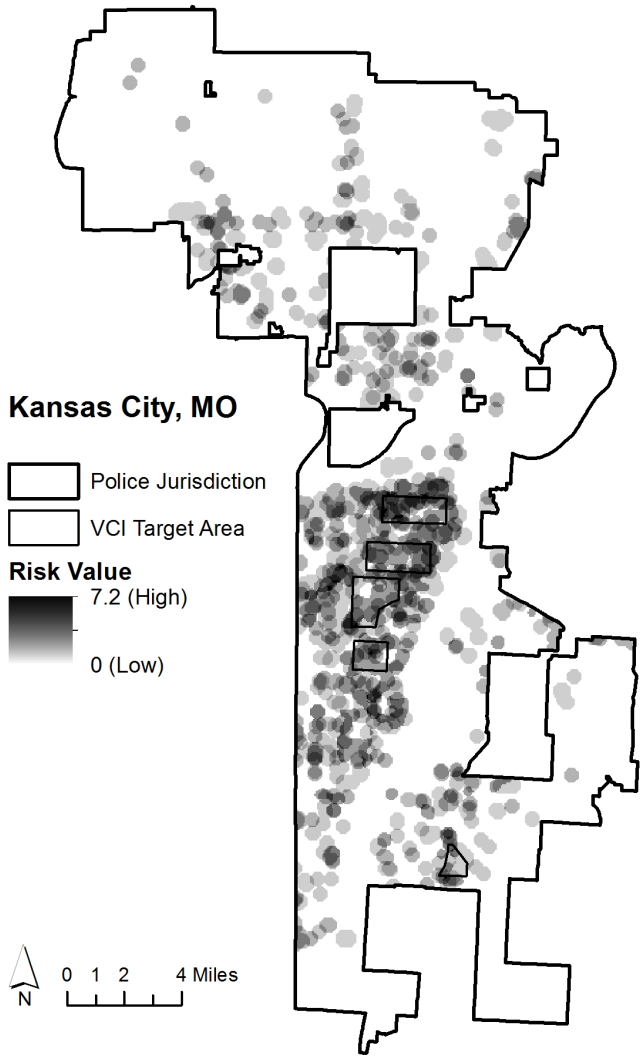

Figure 1. Final Risk Terrain Map.

micro-level. "Risk value", "the number of pre-VCI aggravated assaults", and "whether the place was located in a target area", were included as independent/control variables in a negative binomial regression on the "number of post-VCI aggravated assaults." This model (reasonably) assumes that all target areas received intervention activities, and it measures the extent to which micro-level places within the (treated) target areas affected post-VCI aggravated assaults locations throughout all of Kansas City (at the micro-level).

RESULTS

MICRO-LEVEL CRIME COUNT RESULTS

As shown in Table 3, changes in the mean crime counts per cell were negligible and, with one exception, not statistically significant at $p < 0.05$ (narcotics offenses significantly increased). While the decreases are meaningful to KCPD officials and stakeholders, the absolute change in incidents for up to 90 days after the intervention is not statistically significant at commonly accepted alpha levels (i.e., $p < 0.05$). With an alpha value of 0.079, the decrease in aggravated assaults may be considered marginally significant (Maltz, 1994).

Table 3. Paired samples statistics and tests

Pair	Mean	SD	SEM	t	Sig.
PreAggAssault	0.0370	0.1991	0.0031	1.757	0.079
PostAggAssault	0.0300	0.1870	0.0030		
PreRobbery	0.0179	0.1363	0.0021	0.931	0.931
PostRobbery	0.0176	0.1372	0.0021		
PreNarcotics	0.0549	0.3318	0.0052	-2.119	0.034
PostNarcotics	0.0683	0.4494	0.0070		
PreWeapon	0.0089	0.0941	0.0014	-1.493	0.136
PostWeapon	0.0124	0.1152	0.0018		
PreAllCrimes	0.1188	0.4584	0.0072	-1.127	0.26
PostAllCrimes	0.1285	0.5910	0.0093		

N=4,022; df=4,021

Fifty-nine percent of micro places throughout Kansas City (including the target areas) that had at least one aggravated assault post-VCI (n=407) were also located in hotspots of aggravated assaults pre-VCI (N=142,221; Pearson Chi-Square value=1,525.6; df=1; $p < 0.001$). That is, pre-VCI hotspots of aggravated assaults were frequently host to incidents of aggravated assaults post-VCI. This could be expected according to most hotspots literature (Sherman et al., 1989); it also suggests that the spatial nature of aggravated assaults post-VCI were generally consistent with pre-VCI patterns. The incidence rate ratio (IRR) reported by a negative binomial

regression suggests that if a 250ft x 250ft cell (the unit of analysis) was located in a hotspot of pre-VCI aggravated assaults, then the post-VCI count of aggravated assaults becomes 19 times higher compared to cells located outside of hotspots (n=142,221; IRR=19.206; SE=1.982; z=28.63; $p < 0.001$; 95% CI=15.689-23.512; Pseudo R^2=0.123).

We conclude that the violent crime initiative did not result in a statistically significant reduction of aggravated assaults at micro places within the target areas up to 90 days post-VCI, nor did it alter the general spatial nature of new crime locations throughout Kansas City. At best, one could argue that the reduced number of aggravated assaults within the target areas was practically meaningful, and that the decrease was generally realized (at $p < 0.10$) across all micro places within the target areas. At worst, the VCI had neither significant nor meaningful effects on the occurrence of aggravated assaults at micro-level places; post-VCI aggravated assaults happened mostly where they did before the VCI.

MICRO-LEVEL CONTEXTUAL RESULTS

The weighted risk terrain model yields a statistically valid forecast of the micro-level locations of aggravated assaults both before and after the VCI. According to negative binomial regressions of "risk values" on the "counts of aggravated assaults" in Kansas City: The number of aggravated assaults occurring *before* the VCI was two times higher with every increased unit of risk at a 250ft x 250ft place (N=142,221; IRR=2.034; SE=0.052; z=27.30; $p < 0.001$; 95% CI=1.933-2.141; Pseudo R^2=0.125). The number of aggravated assaults occurring at a micro place *after* the VCI was more than two times higher with every increased unit of risk (N=142,221; IRR=2.114; SE=0.058; z=27.06; $p < 0.001$; 95% CI=2.002-2.232; Pseudo R^2=0.133)[12].

The first hypothesis appears to be true: aggravated assaults, both before and after the VCI, were likely to occur at micro places most suitable for such crimes given the co-existence of certain environmental risk factors at those places. In fact, aggravated assaults were slightly more likely to occur at environmentally risky places after the VCI compared to before. From a routine activities perspective (Cohen & Felson, 1979), perhaps this is because motivated offenders' site selection options to commit new crimes were restricted at known crime hotspots due to increased police presence and heightened states of alert by "suitable" victims at these locations in the aftermath of the highly publicized VCI.

A multivariate negative binomial regression model was used to test the second hypothesis—that the locations of aggravated assaults post-VCI are explained by the existence of environmental risks *and* prior crimes at micro places. Covariates

[12]Spatial autocorrelation was not an issue (Wilson, Hunt, & Brown, 2010) according to results from a Moran's I test (Moran's Index=0.028536; Expected Index=-0.000007; z-score=15.201369; $p < 0.001$), so a spatial lag variable was not included in the regression models.

of "risk value" and "number of pre-VCI aggravated assaults" at each micro place were regressed on the dependent variable of "number of post-VCI aggravated assaults." Results are presented in Table 4. When controlling for the number of pre-VCI aggravated assaults, the risk value of micro places is a significant predictor of the locations of post-VCI aggravated assaults. But, a pre-VCI history of aggravated assaults had a greater effect on the locations of post-VCI incidents. The number of post-VCI aggravated assaults becomes 9.947 times higher with every additional aggravated assault that occurred at the micro place before the VCI, when controlling for risk value.

Table 4. Negative binomial regression on post-VCI aggravated assaults count

					95% C.I.	
Covariates	IRR	SE	z	Sig.	Lower	Upper
Risk Value	2.013	0.053	26.36	<0.001	1.911	2.120
Count of Pre-VCI Aggravated Assaults	9.947	2.473	9.24	<0.001	6.109	16.195

N=142,221; Pseudo R^2=0.151

When controlling for risk value and the number of prior aggravated assault incidents, target areas were more than twice as likely to host aggravated assaults after the VCI compared to non-target areas, as shown in Table 5. This does not necessarily mean that the VCI was a failure—especially since there were meaningful publically-proclaimed measures of success. But because the target areas were selected based on recent-past hotspots of violent crimes, this regression model suggests that the activities of the VCI did not adequately mitigate the variety of attractive qualities of these places to the point where it deterred motivated offenders from returning to commit new crimes after the VCI ended.

Table 5. Negative binomial regression on post-VCI aggravated assaults count

					95% C.I.	
Covariates	IRR	SE	z	Sig.	Lower	Upper
Target Area	2.163	0.310	5.37	<0.001	1.632	2.866
Risk Value	1.909	0.054	22.55	<0.001	1.804	2.019
Count of Pre-VCI Aggravated Assaults	8.860	2.220	8.71	<0.001	5.421	14.478

N=142,221; Pseudo R^2=0.155

DISCUSSION AND CONCLUSION

The spatial dynamics of aggravated assaults did not appear to change in Kansas City over a six-month period from April 28 through October 29, 2010—despite activities of the Violent Crime Initiative (VCI)[13]. The micro-level crime count analysis revealed that the VCI did not yield a significant drop in aggravated assaults at micro-level places within the target areas at commonly accepted alpha levels. The micro-level contextual analysis demonstrated how the presence of environmental risk factors and past aggravated assaults had strong effects on the locations of new incidents, despite the VCI. The top 20% of hotspot places[14] before the VCI accounted for 64% of the places with aggravated assaults afterwards (N=142,221; Pearson Chi-Square=485.759; df=1; $p < 0.001$). The top 20% of highest-risk places accounted for 81% of the places[15] with post-VCI aggravated assaults (N=142,221; Pearson Chi-Square=936.528; df=1; $p < 0.001$). Though there was a slight net decrease in aggravated assaults citywide after the VCI, pre- and post-VCI incidents tended to occur where they always did, in contextually similar types of places.

These findings complement recent computational simulations of crime occurrence conducted by Short, Brantingham, Bertozzi and Tita (2010). Regarding crime in Los Angeles, CA, they simulated hotspot analysis using assumptions about the relative importance of victims, offenders, and guardians in influencing the emergence and movement of hotspots throughout an urban environment. They found that efforts to suppress supercritical hotspots result in only temporarily disrupting crime patterns; new hotspots appear even after police actions are simulated. This is similar to what likely occurred in Kansas City. Short et al., go on to say that suppression over the central area of a crime hotspot drives the elevated risk into a ring surrounding the area of suppression. They are somewhat surprised by these findings as, at least in the case of super-critical hotspots, they run counter to

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[13]Weather and seasonality have been found to effect crime rates in prior research (Ratcliffe, Taniguchi, & Taylor, 2009). But, average weather conditions for the three months prior to the VCI were very similar to the three months after the VCI. Pre-VCI: Mean temperature=74°F, precipitation=0.16in., and wind=7mph. Post-VCI: Mean temperature=72°F, precipitation=0.11in., and wind=6mph. These figures were obtained from the historical archives provided by Weather Underground (available at http://www.wunderground.com/history).

[14]Selected by assigning a random number to all cells in the Kansas City terrain (142,221), then doing a two tiered sort in descending order: first by the number of aggravated assaults, then by random number. The first 28,444 cells (20%) in the ordered list were deemed "hottest hotspots", the remaining 113,777 cells in the ordered list were deemed "not hottest hotspots". The random number allowed for cells with the same counts of crime to fall before or after the 20% cut point.

[15]Selected by assigning a random number to all cells in the Kansas City terrain (142,221), then doing a two tiered sort in descending order: first by risk value (i.e., 0 to 7.2), then by random number. The first 28,444 cells (20%) in the ordered list were deemed "highest risk", the remaining 113,777 cells in the ordered list were deemed "not highest risk". The random number allowed for cells with the same risk values to fall before or after the 20% cut point.

empirical studies that suggest that crime will not displace when suppressed through prevention acts of law enforcement (e.g., Bowers & Johnson, 2004). In their explanation of reasons for why their simulation would run counter to prior displacement research, they suggest it may be due to their assumption in the simulation model that the environments under study are homogeneous. In fact, as reported by Short et al. and as demonstrated in Kansas City, environments are sufficiently heterogeneous. Therefore, crime occurrence can be a function of the character of the environment in which offenders and victims operate, above-and-beyond the concerted actions of police.

It seems that KCPD's strategy for selecting target areas based on known hotspots was appropriate since crimes recur at these locations. In the future, however, risky environments should also be taken into account (Short et al., 2010; Porter & Reich, 2012)—not only for resource allocation, but to plan interventions that focus holistically on deterring and incapacitating offenders, hardening targets, and mitigating one or more risk factors at high risk environments. This micro-level place-based evaluation suggests that a two-prong approach is likely needed to achieve more successful outcomes from evidence-based interventions intended to control and prevent crime. First, there needs to be a longer treatment period to suppress the frequency of aggravated assaults (or other targeted crimes) to the point that hotspots are no longer "hot" and thus no longer perceived by motivated offenders as "tried-and-true" spots for repeat crimes. The reason the VCI target areas were selected at all is because they were chronic and resilient hotspots. So, one likely reason the VCI did not have a substantial effect on aggravated assaults is because the targeted activities were not commensurate with the fact that the target areas were (environmentally) resilient. Future activities must be as sustained as the environment is resilient. Second, VCI activities should focus on mitigating risks posed by both offenders and the environment. Crime hotspots are both a function of the presence of motivated offenders as well as the attractive and/or generative qualities of the environment that serve as cues to offenders that certain places are suitable to commit crimes (Porter & Reich, 2012). Additional research is needed to determine which element of crime events must come first; that is, a suitable environment or motivated offenders who commit multiple crimes to form hotspots. At the point in time when interventions such as the VCI are called for, however, both of these elements likely exist and, therefore, must be mitigated simultaneously.

The increased use of intelligence in policing has encouraged the analysis of crime and related events in the contexts of identifiable patterns of recurring events. In the discussion of these patterns, there have been two trends of analysis. One has been to look at the clustering of crime using density models, identifying hotspots as places in which opportunity for crime coincides with the actions of motivated offenders. The second examines how areas change to become places where crime is more likely to occur. Pattern analysis has encouraged researchers to acknowledge that crime may be matched to the routine activities of victims and offenders. It suggests that certain

areas have a greater tendency towards the occurrence of crime. These are the locations where interventions tend to be targeted (Braga & Weisburd, 2011).

Most evaluations of geographically-targeted interventions use the measure of average crime reduction as a basis for determining success (Braga & Weisburd, 2011). But this study demonstrated how to use complimentary approaches to measuring effects that take into account spatial-contextual dynamics and concentration and dispersion effects. Micro-level spatial analysis techniques provide a way in which police can determine the place-based nature of crimes and the effects of interventions. To our knowledge, since the completion of the Violent Crime Initiative evaluated here, KCPD has already made progress with integrating contextual spatial analysis methods into strategic planning, risk reduction, and evaluation activities (Kansas City Missouri Police Department, 2010b). Patrol divisions are now focusing on known risk factors of crime at high-risk places, and partnering with outside agencies (e.g., Codes Enforcement, Public Works) to address factors of risk outside the police department's purview. According to officials within the Kansas City Police Department, the long term goal is to use spatial risk analysis, including both hotspot mapping and spatial-contextual methods, to continually assess place-based risks and mitigate them with multi-faceted approaches.

It is clear from existing research literature that features of the environment can be incorporated into a crime prevention initiative (e.g., Sherman & Rogan, 1995; Guerette & Bowers, 2009; Hunter & Jeffery, 1997; Eck, Clarke, & Guerette, 2007; Bernasco & Block, 2011). This is particularly important in the case where hotspots are unevenly distributed across an area or where they appear intermittently because of interventions. A profile that includes a hybrid approach, to examine both hotspots and environmental risk factors, should provide a more stable and spatially anchored approach to place-based crime control efforts. In other words, the vulnerability of areas defined by the presence of factors that correlate with crime can be combined with the exposure that comes with past crime incidents to enhance the picture of crime occurrence and to focus strategies for place-based interventions (Caplan, Kennedy, & Piza, 2012). This type of assessment process could be used to improve on the ways in which police both design interventions and assess their effectiveness. As demonstrated above, a spatial analysis of the micro place effects of the VCI on aggravated assault incident locations is particularly important for maximizing the scope and validity of evaluations about location-specific (i.e., targeted) interventions by police. Further, analytical methods that consider the impact of targeted police interventions while controlling for environmental risk factors beyond crimes themselves can serve as diagnostic tools to help interpret why the intervention produced a certain outcome.

It has been more than 70 years since Shaw and McKay (1969) developed a model for the mapping of delinquency in urban areas that emphasized contextual factors. They identified "natural areas" from a series of map overlays for Chicago to demonstrate that certain locations repeatedly experienced crime, despite the social

characteristics of the people who lived there. This situational persistence resided, they said, due to the ways in which the important factors of criminogenisis converged at these areas to create social disorganization. The narrative Shaw and McKay followed suggested a link between bounded areas and behavior without actually being able to substantiate this link (Shoemaker, 1996). Partly because of the reliance on census tracts and official data, Shaw and McKay were constrained in their assumptions about the links between social characteristics and crime. Also, the patterns that they expected, including a decrease in crime emanating from the inner city according to such things as concentric zones, a theory proposed by early ecologists (Park, McKenzie, & Burgess, 1925), could not be demonstrated in their research. This made them susceptible to the criticism that underlying forces of competition and concentration were not being mapped through their analysis. But new advances in geographic information systems, micro-level data, and analysis methods, such as those presented here, provide an opportunity to overcome the limitations faced by Shaw and McKay and others in their efforts to connect characteristics of communities with crime. The clustering of crime at specific places is consistent with the idea of an environmental "backcloth" (Brantingham & Brantingham, 1981) and is well supported by other contemporary research (e.g., Caplan et al., 2011; Eck, Chainey, Cameron, Leitner, & Wilson, 2005; Harries, 1999; Kennedy et al., 2011; Sherman, Gartin, & Buerger, 1989; Weisburd, Morris, & Groff, 2009).

This study follows the theme of spatial analysis that propelled the ecologists in their studies of delinquency. Using modern day computing technology, we demonstrated how locations could be defined by the spatial influence of key environmental factors that connect to crime and its recurrence, even with the presence of "capable guardians" during an intervention period. Police commanders can leverage this information to ensure that future violent crime initiatives "put cops on dots" (Bratton, 1998; Maple, 1999) and put commensurate effort towards mitigating the underlying problems that generate crime.

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