RUTGERS Center on Public Security

BRIEF

Applying Risk Terrain Modeling to Urban Residential Burglary in Newark, NJ

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Residential burglary is arguably one of the most popular index crimes that crime analysts and criminologists have attempted to *predict.* However, with the exception of some scholars (see Groff and LaVigne 2001, 2002) the majority of prior research has focused on 'hot spots' or incident-based maps and has neglected to *operationalize* the environmental backcloth (Brantingham and Brantingham 1993) in which burglaries actually occur. The current pilot study contributes to the literature by addressing the facilitating context of residential burglary and illuminates environmental factors that contribute to and/or mitigate against burglary events from occurring. The study uses the Risk Terrain Modeling (RTM) approach to forecast urban residential burglary (herein known solely as burglary) in the city of Newark, New Jersey. By using this method, the current study moves beyond the reliance on past or instigator events by generating a greater understanding and appreciation for the underlying contextual environment in which particular crimes are more likely to occur.

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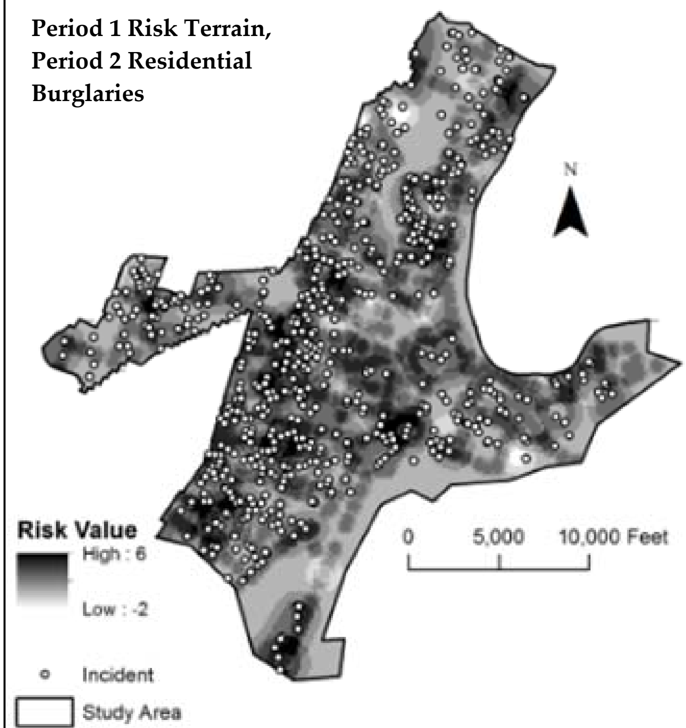
The urban city of Newark was chosen as the setting of the current study since it is the largest city in New Jersey. Considered to be one of the most culturally diverse cities in the United States, the city has made substantial improvements in recent years in several areas, including the economic and industrial sectors. However, Newark continues to struggle with poverty and crime. For example, burglary rates for 2009 were 1,947 per 100,000, compared to national average for similar size cities in the United States of 727.3 per 100,000 (UCR 2009). Recently, the city has laid off 167 police officers as a result of budget cuts resulting in the further limitation of resources available to the Newark Police Department. Thus, cost-effective analytical techniques that can increase the capacity of the practitioners by providing meaningful and useful information that can be used for appropriate and efficient responses are desired. As shown in the figure to the right, the actual study area included only those locations that are within the jurisdiction of the Newark Police Department, so areas including the Newark airport and Port Newark were excluded.

Prior to any application of RTM, a thorough review of the existing literature should be conducted in order to elucidate potential variables, both aggravating and mitigating, that could be included in a subsequent spatial analysis. The experience of the analyst and of practitioners should also be considered in order to consider other potentially relevant factors (Ratcliffe and McCullagh 2001). Importantly, the inclusion of variables should be grounded in theory to help clarify the possible mechanisms and relationships to the outcome of interest, in this case, burglary. For the current case study, there were four key factors that were operationalized to identify an environment conducive for urban residential burglary. Three as aggravating factors (at-risk housing complexes, bus stops, and pawn shops) and one as a mitigating factor (guardian infrastructures). It must be noted that the aforementioned variables are not an exhaustive list of all key variables associated with burglary based on the literature review conducted; however, these were sufficient for the current pilot study.

The most up-to-date data of burglaries from the Newark Police Department was up to August, 2010; however, for the current study, the data was limited to a six-month time period (January 1, 2010 through June 30, 2010). Location data was used to create the risk terrain map for Period 1 (January 1, 2009 to June 30, 2009), which would be used to forecast residential burglary for Period 2 (January 1, 2010 to June 30, 2009). Similar time periods were used in order to control for any seasonal variations and related events (i.e. spring break, beginning of summer holidays, etc). ESRI's ArcGIS 9.3 was used to create the map layers and subsequent RTM map. ArcMap's Spatial Analyst Extension was utilized to convert the datasets into raster map layers. Data were first geocoded to street centerlines of Newark, NJ (obtained from Census 2000 TIGER/Line Shapefiles) to create point features representing the locations of bus stops, pawn shops and guardian infrastructures (police department precincts, fire department fire halls and hospitals) on three separate maps. The fourth risk layer, at-risk housing complexes, was based on data provided by the Newark Police Department and the Newark Housing Authority[i]. Privately owned crime-prone complexes were also included due to knowledge of them being associated with illegal drug markets in Newark (Kennedy et al. Forthcoming; Zanin et al. 2004)[ii], which may also be linked with residential burglary as offenders may burgle a home in order to sustain their drug-use (Mawby 2001; Wright and Decker 1994). Buffers were created around the point and polygon features described and were based on proximity distances that are believed to be at high (HH), high-low (HL), low-high (LH) and low risk (LL) based on the literature and theory.

ArcMap's Density Tool was used to create a raster grid for each map and assign values to identically-sized raster cells (145 feet x 145 feet). The average length of Newark streets was not used due to highway street segments acting as outliers and skewing street measurements; therefore, half the approximate *median* length of a Newark city block (290 feet) was used for the current study. The raster cells were created based on the local concentration of points near each individual raster cell's location. Each risky and mitigating variable was geocoded similarly. Maps were created with raster cell values based on the immediate or nearby accumulation of risk and mitigating variables in each individual cell. Each map layer was then reclassified into two groups with cells given a value (2, 1, -1, -2 or 0) based on their respective risky or mitigating values[iii]. This process was done for all four variables resulting in eight new raster map layers. Importantly, since the cells for all raster map layers were equal in size and were classified in a similar fashion, they could be added together using the Raster Calculator tool to form the subsequent risk terrain map needed to conduct the evaluation on the validity of the RTM.

Period 1 Risk Terrain, Period 2 Residential Burglaries



A binary logistic regression analysis was conducted to assess the predictive validity of the risk terrain map produced from 2009 data on residential burglary incidents that occurred within the first half of 2010 in Newark, NJ. As shown in the table below, the odds ratio suggested that for every one unit increase in risk, the likelihood of a burglary incident occurring increased by 15% ($p < .001$). It should be noted that a Moran's I test was conducted and no spatial autocorrelation was found, therefore no spatial lag was incorporated in the current analysis[iv].

Period 1 Risk Terrain Forecasting Period 2 Incidents								
2-Log Likelihood = 5187.80 Nagelkerke R Square = .006; n = 13948	B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for Exp(B)	
							Lower	Upper
Risk Value	0.14	.03	25.20	1	<.001	1.15	1.09	1.2

The current study shows the utility of RTM in its ability to identify areas where residential burglaries are more likely to occur in the city of Newark, NJ. The use of RTM methods implicitly results in crime analysts and ground-level practitioners to separate themselves from relying on instigator events to occur *before* they can respond. Essentially, RTM enables the potential for proactive, intelligence-led forms of policing to occur as opposed to traditional reactive-based approaches which rely on crimes to occur. Additionally, the identification of risky areas may also identify vital locations with important stakeholders that otherwise may not be recognized (i.e. place managers). Importantly, the current study also accounted for mitigating factors. Arguably, criminology as a discipline has traditionally been focused on factors that increase the risk at a particular area, while neglecting the influence of mitigating factors, especially during the *same* analysis. RTM allows the ability for crime analysts to include both risk-related and mitigating factors in a single analysis thereby being sensitive to the dynamic and inter-dependent relationship of contextual factors. In other words, RTM recognizes that a *criminogenic context* may encompass both forms of risk and security.

It is important to note that the concepts of repeat victimization and the near repeat phenomenon still need to be accounted for. Up to this point, RTM has yet to deal with this issue. Any assessment of residential burglary must take the aforementioned concepts into consideration and they will be addressed in future research. Indeed, it may be found that RTM may compliment the current literature on both prospective mapping and residential burglary by establishing the much-needed baseline risk levels that may result in even more meaningful analysis and interpretation of the so-called 'communicability of risk' (Bowers et al. 2004).

As has been shown, RTM is much more than merely making a map. Theoretically grounded and premised on empirical literature, RTM presents a potentially more efficient and effective alternative to conventional retrospective mapping techniques. By identifying areas that are more susceptible to particular crimes, appropriate responses by both formal (i.e. police) and informal (i.e. place managers) stakeholders can be initiated *before* an incident occurs. In effect, RTM moves crime mapping away from its reliance on past crimes and presents the opportunity to utilize theory, technique and technology in a concerted and proactive way.

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Endnotes

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[i] Many thanks to Eric Piza of the Newark Police Department for providing the data on at-risk complexes and burglaries.

[ii] For a more in-depth description of how at-risk complexes were geocoded, see Kennedy et al (In press).

[iii] Values were based on weighted values for specific variables, for example, one block (500 feet) from a guardian infrastructure was operationalized as -2 (lowest risk value); while, two blocks (1000 feet) was -1 (low risk).

[iv] A Moran's I value of 0 indicates independence or no spatial autocorrelation among geographical units/cells. Using GeoDa (a freestanding software application) and ArcMap's Spatial Statistics Tools, Moran's I value was calculated to be 0.05, respectively, for both software applications.