RUTGERS
Center on Public Security

BRINGING THE PHYSICAL ENVIRONMENT BACK INTO NEIGHBORHOOD RESEARCH: THE UTILITY OF RTM FOR DEVELOPING AN AGGREGATE NEIGHBORHOOD RISK OF CRIME MEASURE

Grant Drawve | Shaun A. Thomas | Jeffery T. Walker

Full Article:
Drawve, G., Thomas, S. A., & Walker, J. T. (2016, online first). "Bringing the physical environment back into neighborhood research: The utility of RTM for developing an aggregate neighborhood risk of crime measure. *Journal of Criminal Justice*. [View in ResearchGate]

Introduction

Risk terrain modeling (RTM) is a spatial diagnostic technique capable of identifying subtle variation in victimization risk across environments based on features of the landscape (Caplan, Kennedy, & Miller, 2010); thus, RTM has been utilized, almost exclusively, to forecast criminal events in micro units (i.e. grid cells or street segments) (Caplan et al., 2011; Drawve, 2014; Drawve, Moak, & Berthelot, 2014; Dugato, 2013; Kennedy, Caplan, & Piza, 2011; Moreto, Piza, & Caplan, 2013). What is not sufficiently understood is the ability of RTM to forecast criminal events in larger units of analysis (i.e. tract, neighborhood, etc.). We propose RTM is capable of advancing the extant neighborhoods and crime due to its ability to provide a quantifiable estimate of risk for neighborhoods based on risk levels across subordinate or micro units. In utilizing RTM to construct an estimate of risk of crime or victimization at the neighborhood or other macro social unit of analysis, it may be possible to more accurately predict neighborhood crime rates by simultaneously accounting for both characteristics of the built environment and social factors known to be robust correlates of levels of crime and violence. The current study contributes to the established literature on neighborhoods and crime and the emerging literature on RTM by developing an aggregate neighborhood risk of crime (ANROC) measure.

Study Setting

This study examines Little Rock, Arkansas, which has about 200,000 residents across 121 square miles. According to Uniform Crime Reports, Little Rock had the 14th (2012) and the 7th (2013) highest violent crime rate of cities in the United States with more than 100,000 residents. As such, Little Rock offers a suitable environment in which to conduct this research considering it

is medium sized yet a relatively violent locale. Like all cities however, crime is not evenly or randomly dispersed across Little Rock neighborhoods. Our goal is to explore the ability of neighborhood physical and social characteristics to assist in the prediction of variation in crime across neighborhoods.

Research Objectives

The study had three general objectives:

1. Use RTM to construct a risk assessment for 2013 violent crime across Little Rock. Similar to prior studies and applications of RTM, it was expected that violent crimes would occur in higher risk cells (at the micro-level).
2. With a risk terrain model constructed at the micro-level, the next objective was to aggregate from the micro-level, or grid cell, to Census Tracts (neighborhoods) to calculate the ANROC measure. It was expected that ANROC would be positively associated with violent crime rates.
3. Finally, we tested ANROC while accounting for a concentrated socioeconomic disadvantage index and residential stability, known correlates of violent crime. We expected that the social factors would significantly predict 2014 neighborhood violent crime rates. Moreover, simultaneously considering both the social *and* physical environments should allow for a more complete understanding of variation in crime across places.

Objective 1 Methodology

Risk factors included banks, big box retail, bus stops, check-cashing stores, convenience stores, fast-food restaurants, grocery stores, hotel/motels, on-site alcohol establishments, liquor stores, lottery retailers, pawn shops, high schools, and tattoo/piercing shops. These were input into RTMDx with specified operationalizations and tested at half-block increments (216ft) up to 4-blocks, resulting in 192 variables. The outcome event was 2013 violent crime incident locations.

Objective 1 Results

RTMDx indicated there were 10 significant risk factors for the 2013 violent crime model (in order of relative risk value, RRV): public high schools, hotel/motels, lottery retailers, big box retailers, bus stops, fast-food restaurants, convenience stores, bars/restaurants, grocery stores, and liquor stores.

Objective 2 Methodology

The aggregate neighborhood (tract) risk of crime (ANROC) value was computed as the average risk score for the grid cells located within the neighborhood. The centroids of each individual cell were used to determine which cells would be averaged to form the aggregate neighborhood

measure. That is, all cells within each tract were used when determining the average risk value for a tract. The neighborhood-level risk value was then utilized in the regression model predicting 2014 violent crime rates.

Objective 2 Results

As expected, the ANROC measure was significantly and positively associated with violent crime rates, and accounted for a substantial portion (36%) of the variation in violence across neighborhoods (see Table 1). This finding supports the extant literature and the importance of understanding criminal opportunities available in neighborhoods to assist in explaining variations in the relative prevalence of violent crime.

Objective 3 Methodology

Data for the social measures was obtained from the American Community Survey (ACS; 2009-2013 5-year estimates). Our measure of concentrated socioeconomic disadvantage is a summary index comprised of the average of six standardized items: median income (inverse), percent unemployed, percent of households in poverty, percent of households receiving public assistance (food stamps/SNAP), percent of residents who are African American, and percent of households headed by a single female with children. A summary measure capturing neighborhood levels of residential stability was also examined. The stability index was constructed through a principal component analysis that included percent of households that are owner-occupied and those in which residents have been in the community for at least a year. These two social measures were tested with ANROC.

Object 3 Results

As expected, both the ANROC measure and the concentrated disadvantage index were significantly and positively associated with variation in violent crime across neighborhoods (Model 2). These measures together explain 49% of the variation in violence across neighborhoods. In Model 3 of Table 1, we remove the concentrated disadvantage index but add the residential stability index to the prediction equation. Once again, the results support our expectations, with both the ANROC measure and the residential stability index exhibiting significant effects on violent crime rates but in divergent directions. The residential stability and ANROC measures combine to account for 44% of the variance in 2014 neighborhood violent crime rates. Our final model, Model 4, includes all three measures to offer a more comprehensive examination. They combined to explain 55% of variation in neighborhood violent crime rates.

Table 1. OLS Regression Results

	Model 1	Model 2	Model 3	Model 4
ANROC	0.612***	0.468***	0.435***	0.326**
	5.059	3.870	3.600	2.694
	(0.944)	(0.903)	(0.944)	(0.953)
Con. Dis.	--	0.398***	--	0.367***
		4.366		4.019
		(1.197)		(1.131)
Stability	--	--	-0.347**	-0.302**
			-3.822	-3.326
			(1.367)	(1.232)
Constant	-3.680	-0.289	0.456	3.021
	(2.889)	(2.760)	(-3.822)	(2.852)
Model Summary				
R^2	.374	.512	.464	.579
Adjusted R^2	.361	.492	.441	.552
Total # Tracts	50	50	50	50
*p<0.05; **p<0.01; ***p<0.001				

Discussion

Social or human ecology based criminological theories are rooted in the intersection of people and place. Both the physical environment and social structure are expected to play a role in the occurrence, frequency, and distribution of crime by differentially exposing individuals to conditions conducive for offending and victimization. Social disorganization is an ecological theory emphasizing the role of the physical and social landscape in examining how community structure generates circumstances conducive to crime and hence exacerbated levels of crime. This represents a substantive contribution to the emerging RTM methods, and traditional communities and crime literatures, by supporting the application of RTM to advance our understanding of neighborhood-level criminological analyses. We believe the development of an ANROC measure to be both an innovative use of the most current and sophisticated analytical methods as well as a substantive addition to our understanding of spatial crime patterns.

References

See full article for complete list of reference citations.