Conjunctive Analysis Report: 6-City Executive Summary

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Background and Overview

Research suggests that crime is not evenly distributed throughout the environment. This can be explained through the presence of *attractors* and *generators* of crime (Brantingham and Brantingham, 1995), or "risk factors," that co-locate to create unique "behavior settings" (Taylor, 1997) that are conducive to illegal activities. Risk terrain modeling (RTM) is an approach to risk assessment that uses existing technology, data, and GIS (geographic information systems) to diagnose the underlying characteristics of the environment that produce crime-conducive behavior settings. RTM produces a map showing the presence or absence of risk at micro-level places. It is used to develop interventions that deploy police officers to high risk places, and to help prioritize crime risk factors for mitigation efforts. However, the conditions that influence crime are highly complex.

It is likely that some interaction effects among certain risk factors in a RTM are stronger than other interactions on the attraction of criminal behavior. If we can imagine an un-weighted 5-factor RTM, places with all 5 risk factors present will have the greatest risk, or likelihood, of crime occurring there. However, places with risk values of "4" should not be treated equal because it is unclear which factor's absence makes the "best" 4-factor model. Should places with factors A, B, C, D be prioritized over places with factors B, C, D, E or vice versa? In this example, several places can have risk values of "4" but have meaningfully different combinations of risk factors. We need a way to test which behavior settings (e.g., bars + parks + schools *or* bars + parks + fast food restaurants) account for the most crime events.

Conjunctive analysis can be used to explore this relative interaction among risk factors by providing empirical evidence demonstrating the interrelationships among factors of the location in question (Miethe, Hart, and Regoeczi, 2008). The end product or output of a conjunctive analysis is a data matrix of behavior settings, which include every possible combination of risk factor interactions and the relative frequency of crimes associated with each setting. Conjunctive analysis can be used to enhance the practical value of RTM by addressing the interrelationships among different factors. More specifically, RTM can be used to empirically identify and validate environmental risk factors. These significant risk factors can then be incorporated into a conjunctive analysis to assess interaction affects among them.

The purpose of this report is to present the power of RTM and conjunctive analysis to examine the spatial context of crimes in various settings throughout the United States. A basic conclusion of findings for Arlington, TX; Chicago, IL; Colorado Springs, CO; Kansas City, MO; Glendale, AZ; and Newark, NJ are presented. For a detailed report on each city, see http://rutgerscps.weebly.com/publications.html.

Risk Terrain Modeling

The Risk Terrain Modeling Diagnostics (RTMDx) Utility[1] was used to produce risk terrain models[2] for the 2,525 incidents of residential burglary that occurred in **Arlington, TX** in calendar year 2012; 2,506 incidents of shootings in **Chicago, IL**; 1,959 incidents of motor vehicle theft in **Colorado Springs, CO**; 629 incidents of robbery in **Glendale, AZ**; 3,468 incidents of aggravated violence in **Kansas City, MO**; and 1,606 incidents of gun violence in **Newark, NJ**.

The RTMDx Utility identified 7 statistically significant risk factors for residential burglary incidents in **Arlington, TX** (apartment complexes, schools, foreclosures, pawn shops, variety stores, convenience stores, and gas stations with convenience stores); Highest risk locations have 16 times greater likelihood of crime than some other locations.

10 risk factors were identified for shootings incidents in **Chicago, IL** (foreclosures, problem buildings, gang hotspots, laundromats, liquor stores, gas stations, 311 requests for all street lights out, schools, bus stops, and bars); Highest risk locations have 77 times greater likelihood of crime than some other locations.

7 risk factors were identified for motor vehicle theft incidents in **Colorado Springs, CO** (disorder calls for service, multifamily housing, foreclosures, parks, sit down restaurants, commercial zoning, and convenience stores); Highest risk locations have 49 times greater likelihood of crime than some other locations.

9 risk factors were identified for robbery incidents in **Glendale, AZ** (drug calls for service, gas stations, apartment complexes, gang member residences, take out restaurants, convenience stores, liquor stores, ATMs, and bars); Highest risk locations have 102 times greater likelihood of crime than some other locations.

15 risk factors were identified for aggravated violence incidents in **Kansas City, MO** (bus stops, weapon offenses, suspicious person with weapon, variety stores, packaged liquor stores, hotels, fast food restaurants, drug markets, bars, rental halls, restaurants, convenience stores, grocery stores, foreclosures and liquor stores); Highest risk locations have 47 times greater likelihood of crime than some other locations.

11 risk factors were identified for gun violence incidents in **Newark, NJ** (narcotics arrests, foreclosures, sit down restaurants, gas stations, convenience stores, take out restaurants, bars, abandoned properties, schools, liquor stores, and problem housing); Highest risk locations have 57 times greater likelihood of crime than some other locations.

Conjunctive Analysis

Once a significant risk terrain model is identified, conjunctive analysis begins and is a fairly straightforward statistical technique (Miethe et al., 2008). The resulting product is a data matrix of the risk factors. When displayed in a table of rows and columns, each row represents a particular behavior setting. Each row also includes the number of observations (i.e., count of micro-places) and the proportional distribution of outcome events for that unique behavior setting.

The most influential behavior setting for burglary in **Arlington, TX** is characterized by *the presence of* the spatial influences of apartment complexes, schools, foreclosures, pawn shops, variety stores, and convenience stores, and *the absence of* the spatial influences of gas stations with convenience stores. The behavior settings with a relative frequency of crime (RFC) above the mean cover about 9% of the study area and account for nearly 40% of all crime incident locations.

The most influential behavior setting for shootings in **Chicago, IL** is characterized by *the presence of* the spatial influences of foreclosures, problem buildings, gang hotspots, gas stations, 311 requests for all street lights out, schools and bus stops and *the absence of* the spatial influences of laundromats, liquor stores, and bars. The behavior settings with a RFC above the mean cover about 15% of the study area and account for nearly 56% of all crime incident locations.

The most influential behavior setting for motor vehicle theft in **Colorado Springs, CO** is characterized by *the presence of* the spatial influences of disorder calls for service, multifamily housing, foreclosures, sit down restaurants, and *the absence of* the spatial influences of parks, commercial zoning, and convenience stores. The behavior settings with a RFC above the mean cover about 4% of the study area and account for nearly 43% of all crime incident locations.

The most influential behavior setting for robbery in **Glendale, AZ** is characterized by *the presence of* the spatial influences of drug calls for service, gang member residences, convenience stores, and liquor stores, and *the*

absence of the spatial influences of gas stations, apartment complexes, take out restaurants, ATMs, and bars. The behavior settings with a RFC above the mean cover less than 1% of the study area and account for nearly 17% of all crime incident locations.

The most influential behavior setting for aggravated violence in **Kansas City, MO** is characterized by *the presence of* the spatial influences of bus stops, weapon offenses, suspicious person with a weapon, drug markets, restaurants, convenience stores, grocery stores, and foreclosures and *the absence of* the spatial influences of variety stores, packaged liquor stores, hotels, fast food restaurants, bars, rental halls, and liquor stores. The behavior settings with a RFC above the mean cover about 4% of the study area and account for nearly 38% of all crime incident locations.

The most influential behavior setting for gun violence in **Newark, NJ** is characterized by *the presence of* the spatial influences of narcotics arrests, foreclosures, sit down restaurants, schools, liquor stores, and problem housing, and *the absence of* the spatial influences of gas stations, convenience stores, take out restaurants, bars, and abandoned properties. The behavior settings with a RFC above the mean cover about 5% of the study area and account for nearly 30% of all crime incident locations.

Discussion

Conjunctive analysis can be used to explore which unique combinations of risk factors identified via risk terrain modeling attract the most incidents of crime in relation to the relative size of the geography involved in its occurrence. The matrix produced by the conjunctive analysis provides a visual tool that highlights how risk factors co-locate at micro-level places to create unique behavior settings for crime. These behavior settings can then be mapped in a GIS for further analysis or resource allocation. For each city (and crime type) in this study, risk terrain modeling identified the risk factors that pose the highest level of risk. Then, conjunctive analysis identified places with particular subsets of these risk factors (e.g., A, B, C, D) to be prioritized over places with *different* and less risky combinations of these factors (e.g., B, C, D, E).

Risk terrain modeling provides public safety practitioners with a tool to empirically identify which features of the environment influence illegal behavior and to develop targeted, risk-based strategies. Conjunctive analysis can be used to evaluate the interactions among risk factors within a RTM to determine which combination of features constitute the most influential behavior settings to be sure that resources are geographically targeted in the most efficient manner.

References

Brantingham, P., & Brantingham, P. (1995). Criminality of place. *European Journal on Criminal Policy and Research*, *3*(3), 5-26.

Miethe, T. D., Hart, T. C., & Regoeczi, W. C. (2008). The conjunctive analysis of case configurations: An exploratory method for discrete multivariate analyses of crime data. *Journal of Quantitative Criminology*, *24*(2), 227-241.

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Endnotes

[1] http://www.rutgerscps.org/software/index.html

[2] Risk terrain models used for these conjunctive analyses were updated after the NIJ project interventions in each city had begun because there are recent improvements to the modeling process and new access to better data sets. So, the risk terrain models presented in this conjunctive analysis report might differ slightly from the models that originally informed the interventions in each city.