RUTGERS
Center on Public Security

BRIEF

A Theory of Risky Places

Leslie W. Kennedy
Joel M. Caplan

Risk is a function of threat, vulnerability and consequence. A theory of risky places considers the effects of all these factors on creating distinct, identifiable areas that are conducive to crime; it emphasizes the importance of environmental characteristics on the emergence, persistence, and desistance of crime. In terms of crime analysis, locations that are vulnerable to crime exhibit certain characteristics that increase the risk of crime to occur. In the following discussion, we lay out how to identify, operationalize, and analyze these relationships.

The risk posed by each criminogenic feature is located at one or more places on a landscape and their confluence at the same place contributes to a risk value that, when raised a set amount, increases the likelihood of crime. This risk value--a measure of the clustering of risk factors, can be used to forecast where crime will occur and (possibly) cluster over a period of time. Risk values are a measure of vulnerability to crime.

The concept of spatial influence refers to the way in which features affect places throughout a location. It is based on the idea that everything relates to everything else, but things that are closer are more related (Tobler's law). If this is true (both in terms of promoting or discouraging certain types of behavior), then the cumulative effects of spatial influence should be such that certain places within the spatial influence of many criminogenic features should be more vulnerable to crime than places that are not influenced by one or more criminogenic features. Defining vulnerable places, then, is a function of the combined spatial influence of criminogenic features throughout a landscape that contribute to crime by attracting and concentration illegal behavior. Spatial influence can be cartographically modeled with a GIS--to produce risk map layers for each criminogenic feature.

Crime incidents can create an event-dependent effect, either because of the changes that take place in response to crime forming hotspots or because of the contagion effect of repeat criminal behavior. Ongoing studies of specific crime prone areas have highlighted the conditions that contribute to their appearance and persistence. As an extension of, or companion to hotspot analysis, the phenomenon of contagion effects has been labeled "near repeats" and explains how past crime incidents can serve as predictors of new crime incidence. Near repeat models assume that if a crime occurs at a location, the chances of a future crime occurring nearby increases. Many near repeat incidents over time could result in crime hotspots.

Propositions

This framework supports three propositions which provide a basis for analyzing the processes whereby crime emerges, persists, or disappears:

1) All places are risky, but because of the spatial influence of criminogenic features, some places are riskier than others;
2) Crime emerges at places when there is high vulnerability based on the combined spatial influences of criminogenic features at said places; and,
3) The overall effect of risky places on crime is a function of differential vulnerability and exposure throughout the landscape.

Testing Propositions

We use burglaries in Newark, NJ for this analysis as they have been the focus of many recent studies on crime contagion.

Spatial Influence of Burglary Risk Factors: Testing Proposition 1

Newark was modeled as a continuous surface grid of 145ft-by-145ft cells, each representing a micro-level place. The spatial influence of each risk factor for burglary was derived from prior empirical literature as well as practitioner justification. Land use parcel data remained in its original form, as a polygon feature. Residential parcels (as opposed to commercial or industrial) were operationalized to be at highest risk of residential burglary since only residences could be targets. The highest risk places associated with at-risk housing were operationalized as all cells within 300 feet of the building footprint of at-risk housing. The highest risk places associated with pawn shops were operationalized as all cells between distances of 300 feet to 900 feet. The highest risk places associated with known burglars' residences were operationalized as all cells between distances of 300 feet to 900 feet. Drug markets were based on 2009 drug arrest locations; Highest risk places were operationalized to be all cells located within the most dense areas for drug arrests (i.e., all cells with density values above +2 SD from the mean density value) and within 300 feet surrounding such areas. All cells within the study area grid that intersected a "highest risk place" received a value of "1"; cells intersecting all other places received a value of "0", denoting "not highest risk".

Each of the resultant risk map layers (from the operationalization process describe above) was spatially joined with all residential burglaries in 2010 (January 1 – December 31; *n* = 1748) to produce a count of burglary incidents located within each cell. So, each cell within each risk map layer had two values attributed to it: 1) a risk value of 1 or 0, according to whether it was located within the spatial influence of a respective risk factor, and 2) a count of the number of burglaries that occurred within it. The unit of analysis for each test was 145ft-by-145ft cells (N=22,975) that comprised a grid of the landscape for the entire study area.

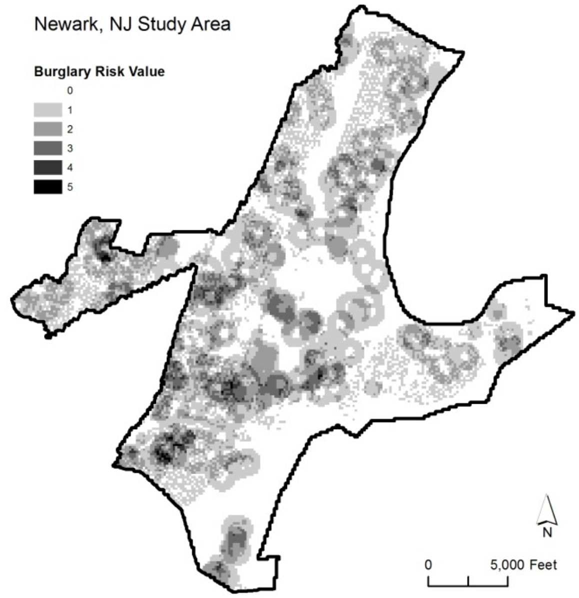
As shown in Table 1, micro-level places operationalized as highest risk according to the spatial influence of residential parcels, at-risk housing, pawn shops, burglar residences, and drug markets—respectively, hosted significantly more burglaries than other places in Newark deemed not highest risk (p<0.05). These findings support Proposition 1.

Table 1: Independent Samples T-Test (unit of analysis is 145ft cell)

Risk Factor	Risky ?	N	Mean	SD	t	df	Sig.
At-Risk Hous.	Yes No	1963 21012	.09 .07	.355 .332	2.038	22973	<0.05
Burg. Res.	Yes No	4017 18958	.09 .07	.372 .325	3.682	22973	<0.001
Drug Market	Yes No	1169 21806	.10 .07	.374 .332	2.855	22973	<0.01
Land Use	Yes No	2236 20739	.10 .07	.384 .328	3.148	22973	<0.01
Public Trans.	Yes No	4129 18846	.08 .07	.346 .332	.688	22973	0.492
Pawn Shops	Yes No	1114 21861	.11 .07	.427 .329	3.763	22973	<0.001

Modeling Vulnerability: Testing Proposition 2

RTM (Caplan and Kennedy, 2010) offers a statistically valid way to articulate vulnerable areas at the micro-level according to the spatial influence of many criminogenic features. The second proposition can be tested with a risk terrain model for residential burglaries in Newark. Places in Newark with high risk values should be more likely to host burglary incidents than places with low risk values. A risk terrain model was created by summing the aforementioned risk map layers whose models of spatial influence were statistically significant. This produced a risk terrain map, as shown below, of micro-level places with values ranging from 0 to 5 (5=highest risk).



Results of a logistic regression suggest that the likelihood of a burglary happening at particular micro places in Newark during 2010 increased by 25% as each additional risk factor affected that place (B=0.229; S.E.=0.028; Wald=66.667; df=1; p<0.001; Exp(B)=1.257; 95%C.I.=1.19-1.33). The predictive validity of the risk terrain model supports Proposition 2 because places that appear to be the most vulnerable on the map are also places where burglaries occurred most often.

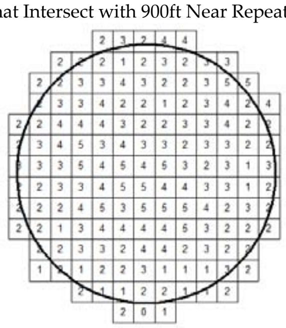
Testing Proposition 3: Vulnerability and Exposure

As our results show, crime does not always occur at the highest risk places. Exceptions can be due to a number of factors. For example, places may be high risk, but motivated offenders may not be present simultaneous to suitable victims/targets. Or, steps may have been taken to reduce crime, hence reducing exposure. This relates to Proposition 3: the overall effect of risky places on crime is a function of vulnerability <u>and</u> exposure throughout the landscape.

Crime tends to occur close to where other crime has happened, particularly in the short term. So near repeat analysis can be used to assess heightened risk at places near to prior crime incidents. The near repeat calculator (Ratcliffe, 2009) was used to determine that near repeat burglaries in 2010 were most likely to occur within 900 feet and two weeks of an instigator event (p<0.01). Given this finding of a near repeat phenomenon, the "Other Functions" tool in the near repeat calculator was used to determine which incidents in a near repeat pair was the instigator and near repeat incidents, which were noted accordingly in the attribute table of the original geocoded point shapefile of all residential burglaries. Then buffers of 900 feet were drawn around each burglary point to connote the expected area for near repeat incidents to occur within 14 days. Average risk (i.e. average vulnerability) for each buffer area was calculated based on the average risk value of all cells from the risk terrain map that were located within each buffer, as demonstrated in the following figure.

The average risk value for all buffer areas was 1.248 (n=1748; standard deviation= 0.540). The average risk value for buffer areas of instigator burglary incidents was 1.376 (n=137; standard deviation = 0.456). The average risk value for buffer areas of non-instigator burglary incidents was 1.237 (n=1611; standard deviation=0.545). These differences are significant at p<0.01, according to results from an independent samples t-test. They are also practically meaningful in that burglary incidents that become instigators for near repeats occur at places surrounded by above average risk. Alternatively, burglary incidents that do not attract near repeats occur at places surrounded by below average risk. This finding suggests that the overall effect of risky places on crime is a function of vulnerability and exposure throughout the landscape. It lends strong support to Proposition 3.

Example of Averaging Method for Risk Values of Cells that Intersect with 900ft Near Repeat Buffer



Shown here: n cells=148
Mean Risk Value of Buffer Area = 2.75

The proportion of risky places (i.e. cells) is greater for buffer areas of instigator incidents than for non-instigator incidents; proportions are calculated as the number of cells with risk values greater than or equal to 1 divided by the total number of cells within the 900 foot buffer area. The average proportion of risky cells within 900 feet of all burglary incidents is 0.754. The average proportion of risky cells within 900 feet of instigator events 0.811. The average proportion of risky cells within 900 feet of non-instigator events is 0.749. These differences are significant at p<0.001, according to results from an independent samples t-test. They are also practically meaningful in that burglary incidents that become instigators for near repeats occur at places with above average proportions of nearby high-risk places. Alternatively, burglary incidents that ultimately do not attract near repeats occur at places with below average proportions of nearby risky places. This result further supports Proposition 3.

Conclusion

Risk that comes from increased vulnerability tied to features in the environment, and the exposure that derives from crime incidents, concentrates at places and influences the new crime patterns that occur there. The theoretical propositions that we offered in our test of the theory find support using burglary data from Newark.

When crime disappears from vulnerable places, should these places still be considered unsafe or suitable areas for crime to occur again? The answer based on findings of the validated risk terrain model (discussed above) is yes. Vulnerability does not change unless one or more factors that comprise the risk terrain model are mitigated. The spatial-temporal context for crime is merely exacerbated when vulnerable places are located near recent past crime incidents. Risky places are formed as a result of the confluence of the spatial influence of certain factors combined with conditions of exposure. Crime location forecasting, therefore, must incorporate spatial vulnerabilities and exposures at micro-level places if it is to yield the most efficient and actionable information.

References

Caplan, J. M. and Kennedy, L. W. 2010. *Risk Terrain Modeling Manual*. Newark: Rutgers Center for Public Security.

Ratcliffe, J. H. 2009. *Near Repeat Calculator (version 1.3)* Temple University, Philadelphia, PA and the National Institute of Justice, Washington, DC.