Geography of the Baltimore Drug Trade

Mapping Urban Youth Vulnerability to Employment in the Open-Street Drug Market and its Correlation to Crime and Environmental Influences

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INTRODUCTION

The Nature of the Illegal Drug Trade

"We can't stop it.

Not with all of the lawyers, guns and money in this world. Not with the guilt or morality or righteous indignation. Not with the crime summits, or task forces, or committees. Not with the policy decisions made in places that can't be seen from the lost corner of Fayette and Monroe." [1] I've driven through that intersection, dabbled with rundown corner stores and boarded up houses. I've driven through section-8 housing and been called out to by touts who want to make a quick sale. But I haven't even scratched the surface of Baltimore's inner-city struggles.

Baltimore is no anomaly among American cities that struggles with stability in the face of the illegal drug market. America's war on drugs is an ongoing patchwork attempt to fix a complex socio economic, environmental and politically rooted problem, an oscillating problem. With the introduction of cheap readily accessible crack cocaine to impoverished inner-city neighborhoods in the 1980s, the drug epidemic began to take strong hold of once stable neighborhoods.[2] In Baltimore's case, crack cocaine took over many neighborhoods on the East and West sides, which were then introduced to heroin. A domino effect altered other societal elements, and school systems, incomes, family compositions, housing, community ownership and aesthetics, job availability, mental health, nutrition, and social services began to deteriorate. Cyclically, drugs became both a cause and effect of community deterioration, leaving those trapped inside little hope to get out.

Due to the hidden nature of any illegal activity, it's often difficult to accurately observe, quantify, analyze, and control the resulting problems. While the open-street drug market similarly resembles the structure of a legitimate economy, most rules are implicit and lack order.[3] The illegal open-street drug market in Baltimore is not acceptable because it is a direct detriment to society. It directly and indirectly causes crime, poverty, environmental blight, and it prevents neighborhoods from maintaining stability and growth. As a result, illegitimate employment in the drug market risks one's safety, health, and legal status. In addition, since the majority of individuals and groups involved in the open-street drug market are of low economic and/or of minority status, it becomes easier for peers of a similar status to become involved. It's an unfortunate yet understandable cycle that is often ineffectively combated from minimal directions and without positive approaches. Tactics to reduce the supply-side rarely yields more than increased arrests, and campaigns to revitalize communities often lose the majority of funding during translation.[4] With Baltimore's limited funding and multi-directional agendas, what new approaches can be used to help solve this issue?

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[1] Simon, D. 1997. *The Corner*. New York, 58.

[2] Drug Dealing, 31

[3] Youth Drug Abuse, 243

[4] Drug Dealing, 33

Motivation

I have grown up and lived in the Baltimore area for my entire life. My permanent residence is less than half of a mile away from the city's north border, and I attend UMBC, which is a third of the way around the beltway from my home. However, like many affluent and middle-class suburban residents, I have been oblivious to the poverty, crime, drug-use, and decay that exists just a few miles further. As a humanitarian and as an individual who uses the city's infrastructure and services, I believe that it's my duty and the responsibility of the abled to help the less fortunate. During an internship in the summer of 2012, I discovered the copious amount of Baltimore's urban blight through aerial photography and street-level imagery. My curiosity developed into risky urban tours, data mining, and time spent watching, *The Wire* and reading *The Corner* by David Simon. I have developed an attachment to the city, and I want to help it return to it's thriving status that it hasn't seen since the 1950s. I've also come to question the effectiveness of the city's government. How, in modern America, do we allow for 8.7% of teens sixteen to nineteen to not be enrolled in school or in the labor force,[5] over 16,000 documented homes (plus over 10,000 lots) to be vacant,[6] and for over 1/10th of the population to be Heroin abusers?[7]

The Role of Spatial Analysis

The purpose of this class assignment is to generate a research question, conduct a background investigation, conduct geospatial analysis, and attempt to answer the question with a spatially related result. GIS is a composition field that utilizes information systems and tools to capture, manipulate, analyze and visualize spatial data. We sometimes use GIS to, answer the questions 'What is where?' and 'Why is it there?' We use GIS to detect and recognize spatial patterns and investigate the process that shape them. This type of analysis is fitting for understanding Baltimore's illegal open-street drug market because the drug trade is environmentally based in nature. Locations for supply and demand of the market, and the resulting consequences depend on geographic accessibility, inhabitants, and environmental conditions. For example, I believe that areas located within and around public housing away from police security cameras are more suitable for trade due to the likely desire from an impoverished population, and the limitation of police observation.

The goal of this project are to spatially determine and understand Baltimore youth vulnerability, and answer the question, can GIS analysis can assist by generating a youth social vulnerability index, conducting crime hotspot analysis, conducting environmental proximity analysis, and deterring the relationship between the three?

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[5] Drug Dealing, 33

[6] When Work Disappears, 7

[7] Youth Drug Abuse, 8

BACKGROUND

Literature Review

The majority of literature review focuses on youth vulnerability and the connections that youth establish with the illegal drug market. In addition, several articles focuses on the causes for the dramatic rise in youth crime, especially violent crime, within the last few decades. Many sources describe a common trend where once a variety of factors cause a community to deteriorate socially, economically and aesthetically, that community enters a cycle of stress that is hard to get out of. Many of those involved often succumb to the negative aspects of the community and find it hard and/or unimportant to revitalize their environments and/or find legitimate work. As an example, "Despite being socially integrated, the residents in Chicago's ghetto neighbourhoods share a feeling that they have little informal social control over the children in their environment. A primary reason is the absence of a strong organisational capacity or an institutional resource base that would provide an extra layer of social organisation in their neighbourhoods."[8] When legitimate work disappears, many individuals become stuck in a poverty loop and can't change their place of residence. Individuals find that they begin to lack, "not only a place in which to work and the receipt of regular income but also a coherent organisation of the present — that is, a system of concrete expectations and goals. Regular employment provides the anchor for the spatial and temporal aspects of daily life."[9]

Besides limited job availability, the lack of a strong community network can make it difficult for healthy family structures. "It is easier for parents to control the behaviour of the children in their neighbourhoods when a strong institutional resource base exists and when the links between community institutions such a churches, schools, political organisations, businesses, and civic clubs are strong or secure."[10] Many times, parents are preoccupied with their suffering lives to support a household and/or children, making youth susceptible to non-nurturing relationships. Youth are distanced from influence of the legitimate workforce because, "mothers, saddled with child-care responsibilities, can prevent a slide deeper into poverty by accepting welfare," and when present, fathers are, "are more likely to become idle as a response to restricted employment opportunities."[11] Children begin to interact with those of a similar skillset, beginning the reinforcement of poor habits.[12] In contrary, improved social conditions lead to, "higher levels of residential satisfaction and ultimately to greater neighborhood stability, as defined by longer lengths of tenure, stable property values, improved property upkeep, and stable social conditions."[13] When homes are kept up, management and organizational transferable skills are developed, invigorating further interest in the community.[14]

As either a cause or an effect of deteriorating neighborhoods, drugs are introduced and often welcomed by these susceptible populations. Although when

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[8] When Work Disappears, 6
[9] When Work Disappears, 3
[10] When Work Disappears, 6
[11] When Work Disappears, 4
[12] When Work Disappears. 6
[13] Home Ownership & Neighborhood Stability, 42
[14] Home Ownership & Neighborhood Stability, 54

compared to adults youth are usually less involved with major illegal activity, crime begins to trickle down and the opportunities for potential high income, influence and power through drug dealing become appealing. Some youth sell drugs to support their own habits and/or to demonstrate their abilities. "Opportunities for risky experimentation and lack of opportunities for constructive expression of emerging identities and capacities lead to higher incidents of high-risk behavior and poorer mental health outcomes for urban youth."[15] A study designed to generate a geospatial database of youth substance abuse suggests that many youth social variables are unquantifiable, but that their, "social networks are constituted by space (physical world), [and] place (socially constructed), which influence our interpretations of meaning, and our sense of self.[16] And although this study doesn't focus on racial differences, the majority of Baltimore's population is black who are suggested to, "more likely perceive that marijuana, cocaine or heroin would be easy to obtain … [and are more likely] to have seen someone selling drugs … and to have seen someone who was drunk or high."[17]

Since the illegal drug market is a hidden, dangerous, competitive, and high-risk market, many individuals involved carry firearms and/or other weapons for protection and/or power. Many surveyed high school students have claimed to have possessed a firearm within the past twelve months for safety but another study suggests that when, "disputes arise, no matter how minor, youth who carry guns may use them preemptively, especially if they suspect that their adversaries also have guns."[18] It then becomes an arms race that parallels the increase in other crimes. Like supply and demand of other markets, the drug market is dynamic but follows similar rules. They usually operate in fixed well-defined geographic areas and have a continuous labor supply.[19] Since the crack epidemic in the 1980s, Baltimore's drug markets has needed cheap and easy labor to replace those who have been incarcerated or to expand territory, making youth preferable employees. This poses a challenge to police that often see ineffective results from, "simply arresting market participants."[20]

Data Sources

These studies suggest similar influential variables when observing youth vulnerability. Many of these variables are both directly and indirectly present in a youth's life, but based on observation, higher-level factors, such as a parent's income, significantly affect dependents and can therefore be used for analysis. A study looking at the index of youth vulnerability generates maps for high school dropout rate, teen birth rate, juvenile arrest rates, median household income, and out of school and out of work, implying that higher levels of these components (besides median household income) produces a more vulnerable population.[21] A study on tenureship notes that property values, property physical conditions, family

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[15] Substance Use, Social Networks, And Geography, 4
[16] Geospatial Database, 22
[17] Youth Drug Abuse, 240
[18] Future of Children, 46
[19] Drug Markets, 7
[20] Drug Markets, 8
[21] Index of Youth Vulnerability, 8

composition, length of tenure and housing quality are all important influences.[22] When quantifying substance abuse, studies categories youth development into several environmental structures including microsystems, mesosystems, exosystems, and macrosystems.[23] From microsystems with peer rejection to exosystems like social and church services to macrosystems like cultural drug views, each level helps define a community and its youth.[24] [25] A study on the future of children, guns and violence notes that the factors contributing to the youth violence epidemic, which likely duel youth homicide, include the availability of handguns, increased carrying, and the growth of illegal drug markets.[26] The following datasets were gathered and generated based on the findings above. *(see figure 1)*

METHODOLOGY and RESULTS

Datasets Generated

The following table depicts the individual datasets that were compiled and used for the various forms of analysis. Data was gathered via four portals including:

- U.S. Census Tiger/Line (2010 census data with demographics; 2009 - 2012 American Community Survey)
- Open Baltimore (Baltimore Police Department; 2009 - 2014 Victim Based Crime; 2012, 2013 arrests)
- Maryland Food System Map (Baltimore Department of Planning; Johns Hopkins University)
- * Baltimore Neighborhoods Indicator Alliance (City Health; MD DHR; American Community Survey;; City Housing; Maryland Property view; BCPSS;)

Dataset	Retrieved From	Source
Youth Vulnerability Index		
Demographic Data	Tiger/Line	2008 - 2012 American Community Survey
Housing Data	Tiger/Line	2008 - 2012 American Community Survey
Community Statistical Areas	BNIA	various sources*
Crime		
2012, 2013 Arrest and Charges	Open Baltimore	Baltimore Police
2009 - 2014 Victim Based Crime	Open Baltimore	Baltimore Police
Environment		
Vacant Houses & Lots	Open Baltimore	Baltimore Dept. of Planning
Land Cover & Land Use	Open Baltimore & Maryland Food System	Baltimore Public Works; JHU
Community Resources	Open Baltimore & Maryland Food System	Baltimore Dept. of Planning; JHU

Figure 1. Datesets generated

[22] Home Ownership, 54
[23] Substance Abuse, Social Networks, Geography, 5
[24] Geospatial Database, 23
[25] Youth Drug Abuse, 243
[26] Future of Children, Guns and Violence, 33

Procedures

1. Generate an urban youth social vulnerability index

In order to generate a vulnerability index, an array of variables were observed and then compiled to assess overall vulnerability. The resulting vulnerability score is relative based on it's relation to every other location in the city. Therefore, block-groups with a high vulnerability is high in relation to only areas within Baltimore city. Once block-group data was gathered and compiled into a single ArcMap shapefile layer, variables were grouped and headers were organized. At this point, many variables were thrown out for various reasons primarily including lacking applicability, lacking portions of data, and/or insignificant numbers. Community Statistical Area data was aggregated to 2010 block-group level by assigning values based on the relative proportion of the total to the proportion of the block-group area. For example, if a community statistical area has a rate of 50 juvenile arrests per 1,000 juveniles, a portion of 50 would be assigned to an inset block group-based on that block-group's area compared to the larger community statistical area. These numbers would then be multiplied by the number of 1,000 juveniles to get the total number of arrests in that area.

Once over 30 variables in six groups including economic, educational, family, employment, poverty and household, overlapping variables based on high correlation were removed. *(see figure 8.1., 8.2.)* This was done using the ordinary least squares linear regression tool.To then statistically determine the significance of each variable (and variable group), the finalized variable table was imported into myStat where a principal component factor analysis tool was run. This tool determined the significance of each variable, the relationship that each variable had to one another, and assigned a respective weight to be used for future formula composition. *(see figure 2)* A social vulnerability index was generated using the following formula:

*Social Vulnerability Index = Sum[(weight *value) /value max]*

Where weight is the principal component generated weight, value is the block-group's variable value, and value max is the maximum value for that variable. This generated a range from approximately -2.8 - 4.0 where the higher the number, the higher the social vulnerability. *(see figure 9)* Since there were significantly high outliers, eight groups were removed re-symbolized. *(see figure 10)*

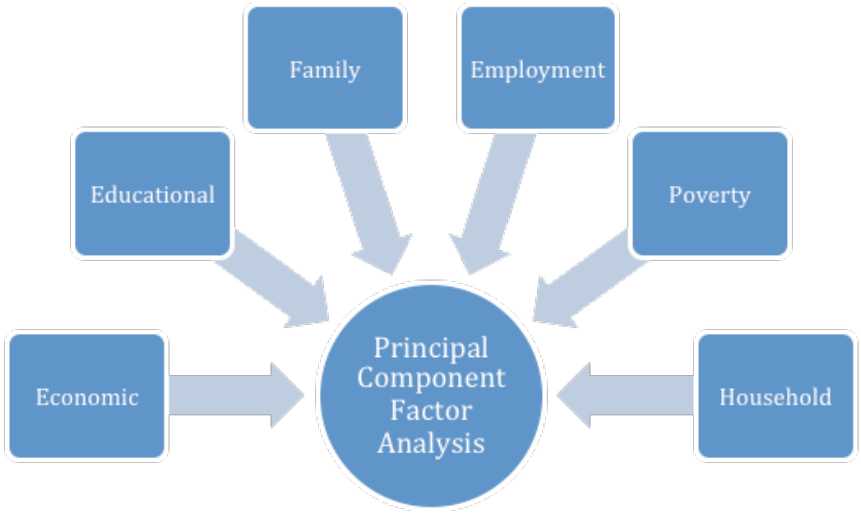

Figure 2. Principal component factor analysis procedures

2. Hotspot and proximity analysis on citywide crime

To study city crime, victim based crime for 2009 - 2014, narcotics arrests for 2012 and 2013, and violent arrests for 2012 and 2013 were mapped. Point data without location data were removed (approx. 8,000 records total), and data was spatially joined and aggregated to 2010 block-groups layer. Observed crime categories were then normalized by area, population, population density, as well as broken down into median age of criminal and number of crimes committed by minors. To begin conducting analysis, an appropriate threshold distance for analysis was determined to be 450ft based on z-score results. *(see figure 3)* Hotspot analysis was run for five final variables, 2012 and 2013 narcotics arrests normalized by area, 2012 and 2013 violent offenses arrests normalized by area, and total victim based crimes. *(see figure 11)* To test statistical significance, Moran's I spatial autocorrelation tool was run on the resulting residuals to test the reliability of the results. *(see figure 13, 14).*

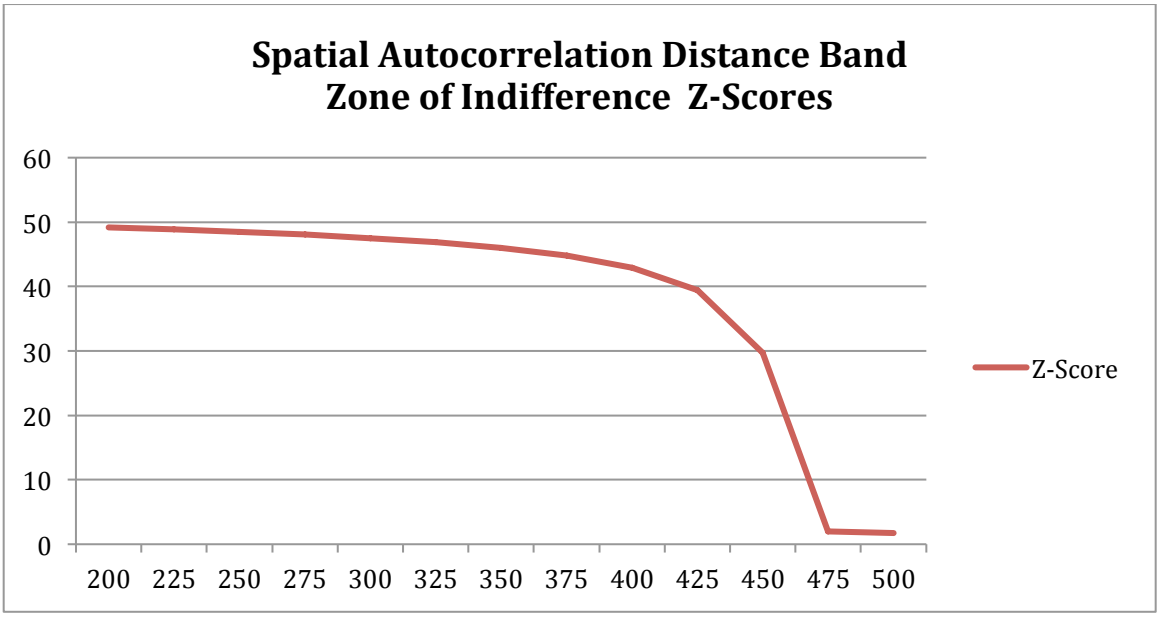

Figure 3. Z-scores for optimal distance threshold for hot spot analysis

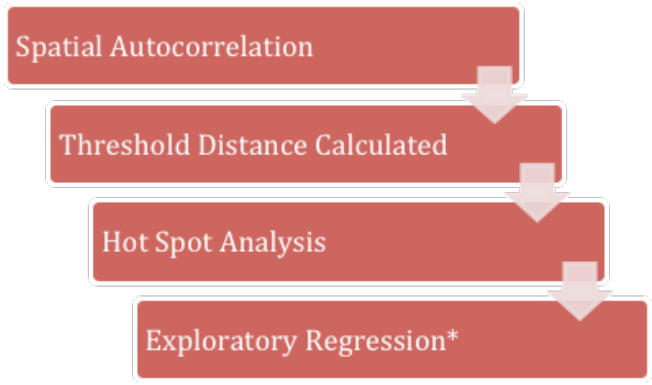

Figure 4. Crime analysis procedures

3. Proximity analysis on the concentration of + / - environmental community factors

With time constraints, this section was reduced to simply observing the number of occurrences of vacant buildings and lots. Point data that was tied to parcels was spatially joined and aggregated to the 2010 block-group level. These vacant lots and buildings are only the ones observed and categorized by the City of Baltimore. *(see figure 12)* Other data that was planning on being observed included: community and recreation centers, parks, community gardens, co-ops, urban farms, as well as brownfields, superfund sites, land cover / land use.

Figure 5. Environmental analysis procedures

4. Testing for correlation between #2 and #3 to #1

To test for correlation, social vulnerability was compared against each of the five crime variables and the negative environmental variable through ordinary least squares linear regression. The Morans I spatial autocorrelation tool was run on the resulting residuals to check the reliability of the results. The results were not expected as discussed within the discussion and results sections. *(see figures 6, 7)*

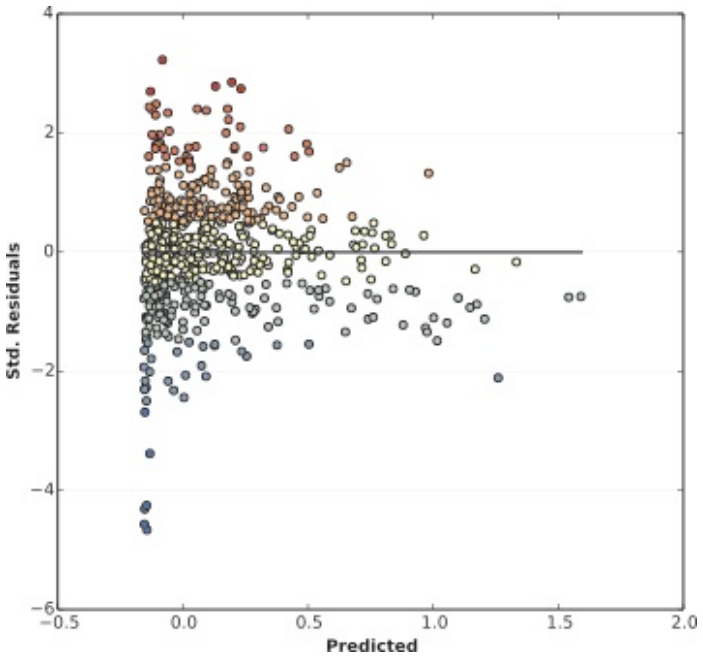

Figure 6. Unusual distribution of residuals for crime tested against social vulnerability

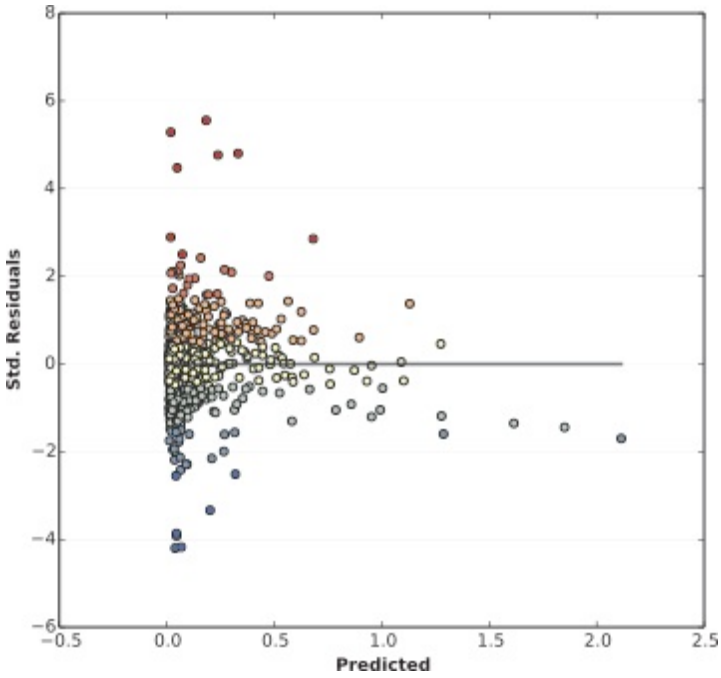

Figure 7. Unusual distribution of residuals for crime tested against social vulnerability

Raw Variable Label	Description	Usage	Reason for removal
Block-Group			
_PopNFHH	Population number not living in a family	✓	
_PerPTran	Percent population commute without personal vehicle	✓	
*_PerOC_NF		X	Unreliable data
*_PerOC_SP		X	Duplicate and unrelible data
_PERFC	Percent of childeren under 18 who are foster children	X	Limited effective data & incorrect weight
_PerFPov	Percent of families living uner poverty	✓	
_MedHHInc	Median household income	✓	
_PerHHsnap	Percent of households receiving SNAP	✓	
_PerHHdisb	Persent of households with 1+ disabled persons	✓	
_PerLFuemp	Percent of labor force currently unemployed	✓	
_Own_OVC	Percent of owned housing units with overcrowding (>1.5ppl/room)	X	Limited effective data
_Own_NoVeh	Percent of owned housing units without vehicle access	X	Clustering w/ PerPTran (SEE2)
_Ren_OVC	Percent of rented housing units with overcrowding (>1.5ppl/room)	✓	Limited effective data
_Ren_NoVeh	Percent of rented housing units without vehicle access	X	Clustering w/ PerPTran (SEE3)
_LackKitch	Percent of households lacking complete kitchen facilities	?	Clustering w/ PerFPov (SEE5)
_PerGRInc	Average gross rent as a percentage of average total income	?	Clustering w/ PerFPov & PerHHInc (SEE6)
_MedHHValu	Median houseing unit value	✓	
_PerHH50K	Percent of housing units valued under $50,000	X	Limited effective data & incorrect weight
_Per_HSG	Percent of population over 25 years that hasn't graduated high school	✓	
Community Statistical Area			
TBR1000	Teen birth rate per 1,000 females	✓	
Liquor1000	Liquor store outlet density per 1,000 residents	✓	
MSCA	Middle school chronically abscent rate	X	Clustering w/ HSCA (SEE 1)
HSCA	High school chronically abscent rate	✓	
CrP1000	Property crime rate per 1,000 residents	✓	
CrArr1000J	Juvaniel arrests per 1,000 juveniles *based on population under 18	✓	
CrVO1000J	Juvaniel violent offenses per 1,000 juveniles *based on population under 18	?	Clustering w/ CrVO1000J (SEE 4)
CrDC1000J	Juvaniel drug charges per 1,000 juveniles *based on population under 18	?	Clustering w/ CrVO1000J (SEE 4)
DomVio1000	Domestic violence charges per 1,000 residents	✓	
NbhAssoc	Number of neighborhood associations	X	To be used in environmental analysis
ParkGroups	Number of park and environmental stewardship groups	X	To be used in environmental analysis
CommGard	Number of community gardens	X	To be used in environmental analysis

Figure 8.1. Variables used to generate social vulnerability

1

Moran's Index:	0.037477
Expected Index:	-0.001534
Variance:	0.00002
z-score:	8.723481
p-value:	0

2

Moran's Index:	0.151742
Expected Index:	-0.001548
Variance:	0.000038
z-score:	24.816846
p-value:	0

3

Moran's Index:	0.045926
Expected Index:	-0.001548
Variance:	0.000022
z-score:	10.221371
p-value:	0

4

Moran's Index:	0.057539
Expected Index:	-0.001548
Variance:	0.00002
z-score:	13.320079
p-value:	0

5

Moran's Index:	0.03647
Expected Index:	-0.001548
Variance:	0.000017
z-score:	9.354109
p-value:	0

6

Moran's Index:	0.027019
Expected Index:	-0.001548
Variance:	0.000021
z-score:	6.194467
p-value:	0

Figure 8.2. Moran's Index for removed variables

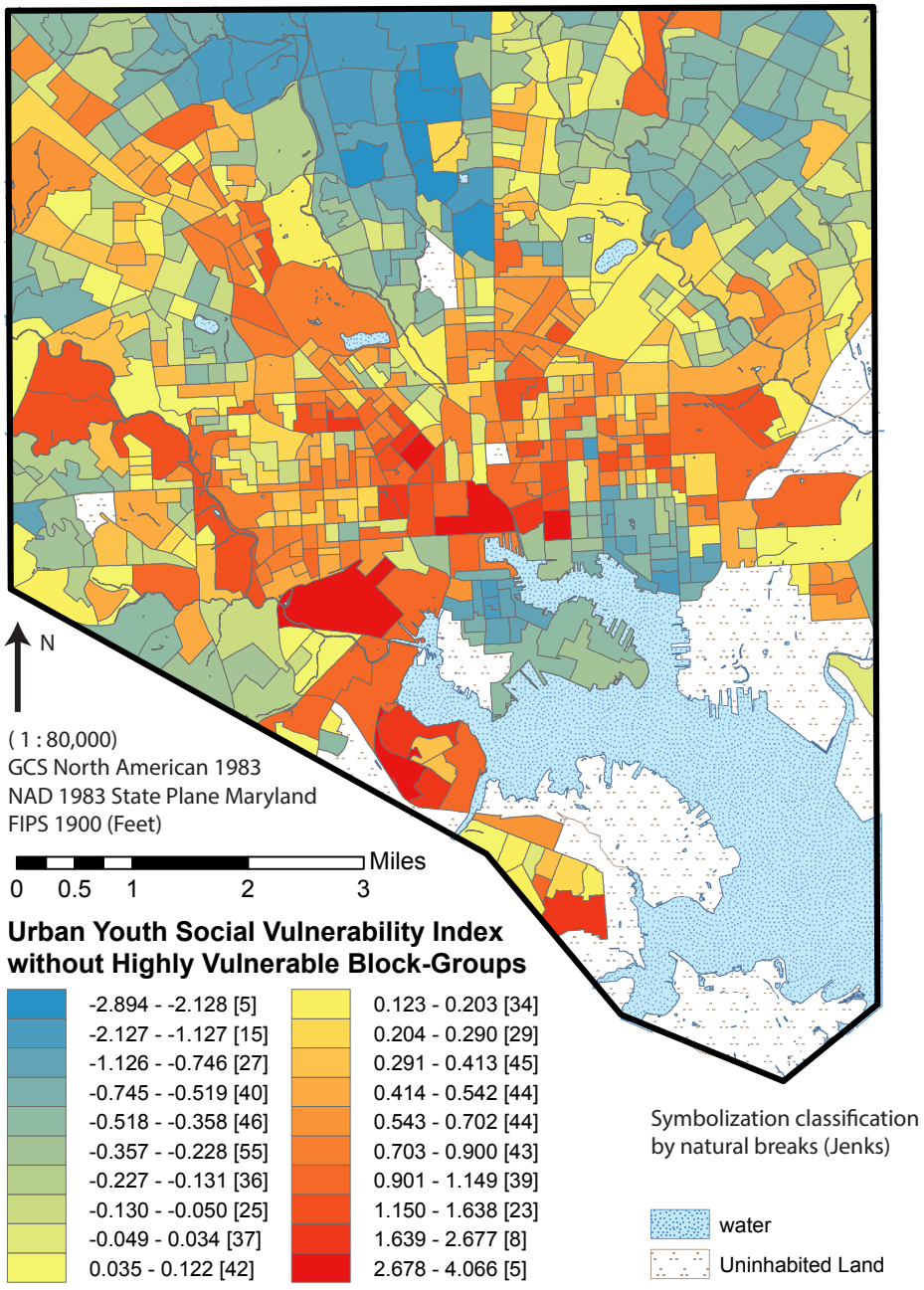

Figure 9. Social Vulnerability

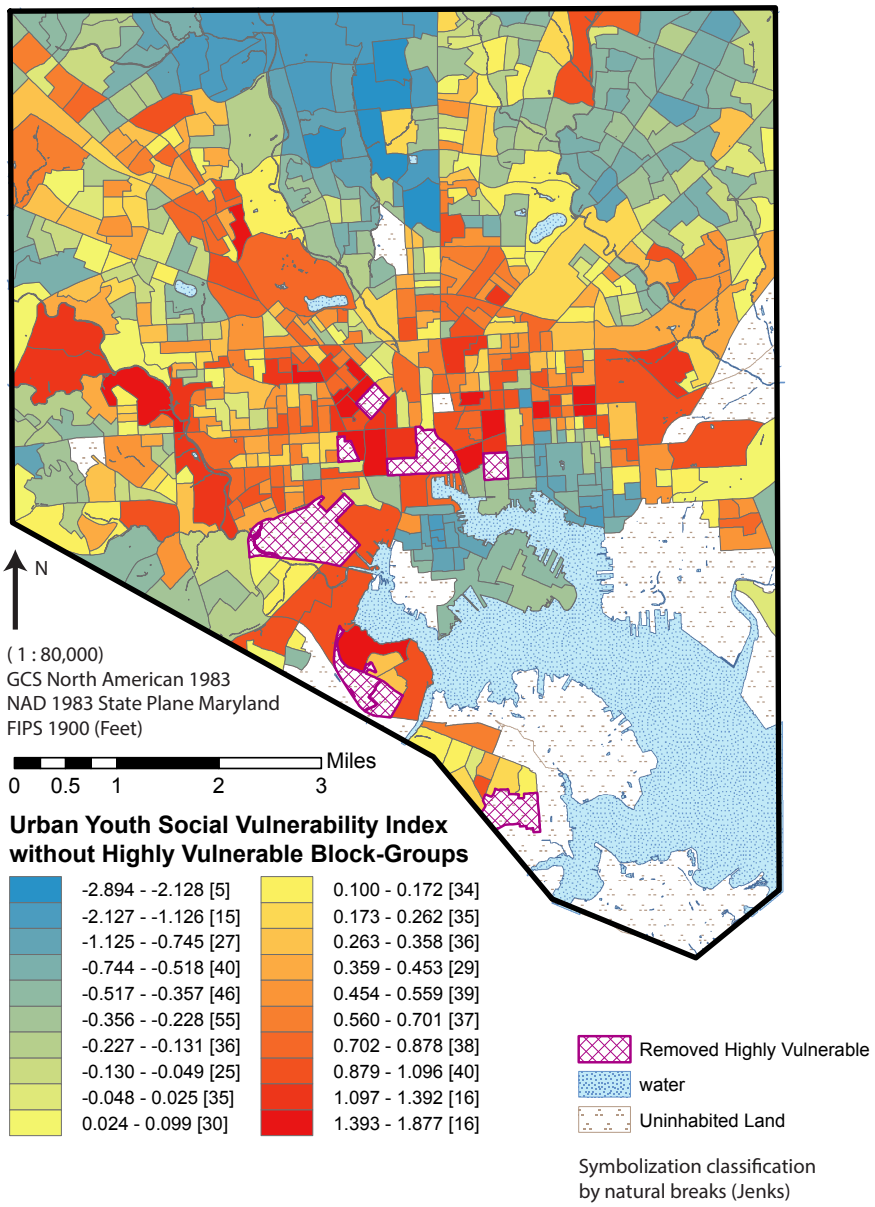

Figure 10. Social Vulnerability with outlier highly vulnerable areas removed

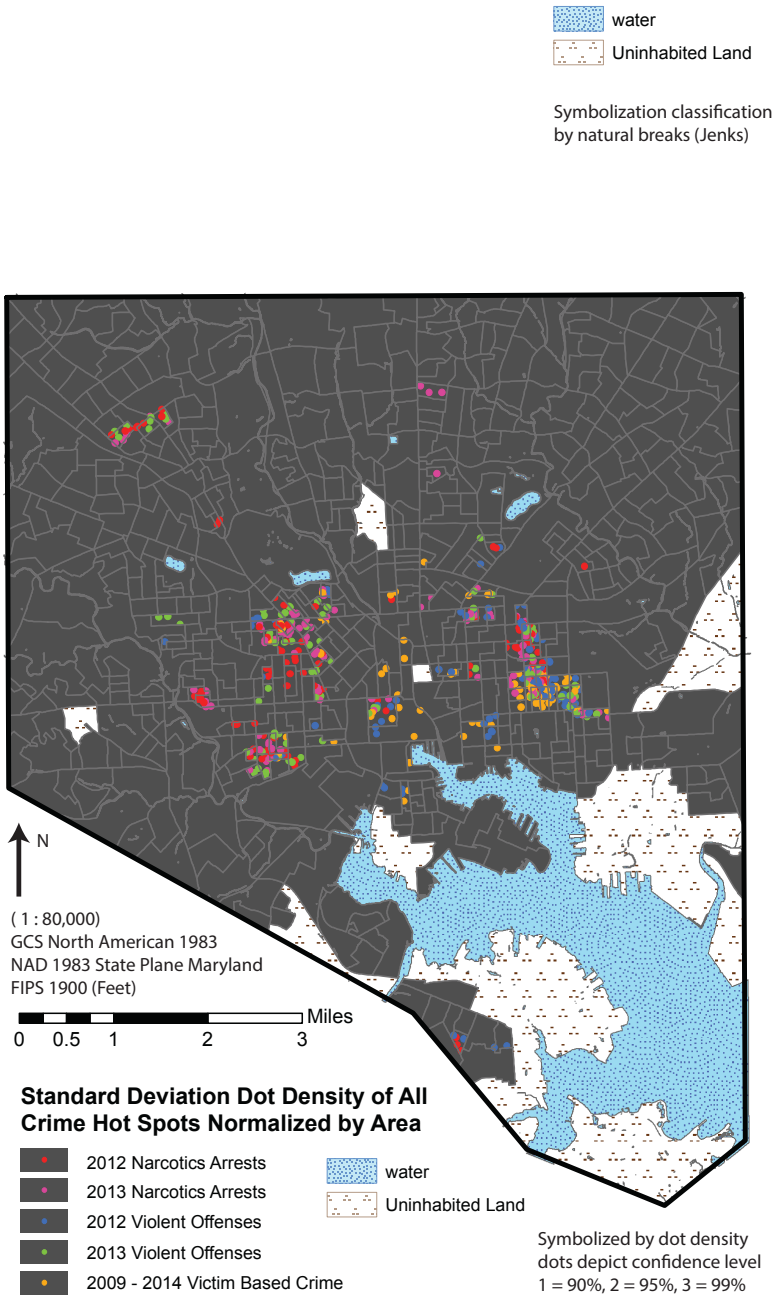

Figure 11. Dot density of all crime hot spots

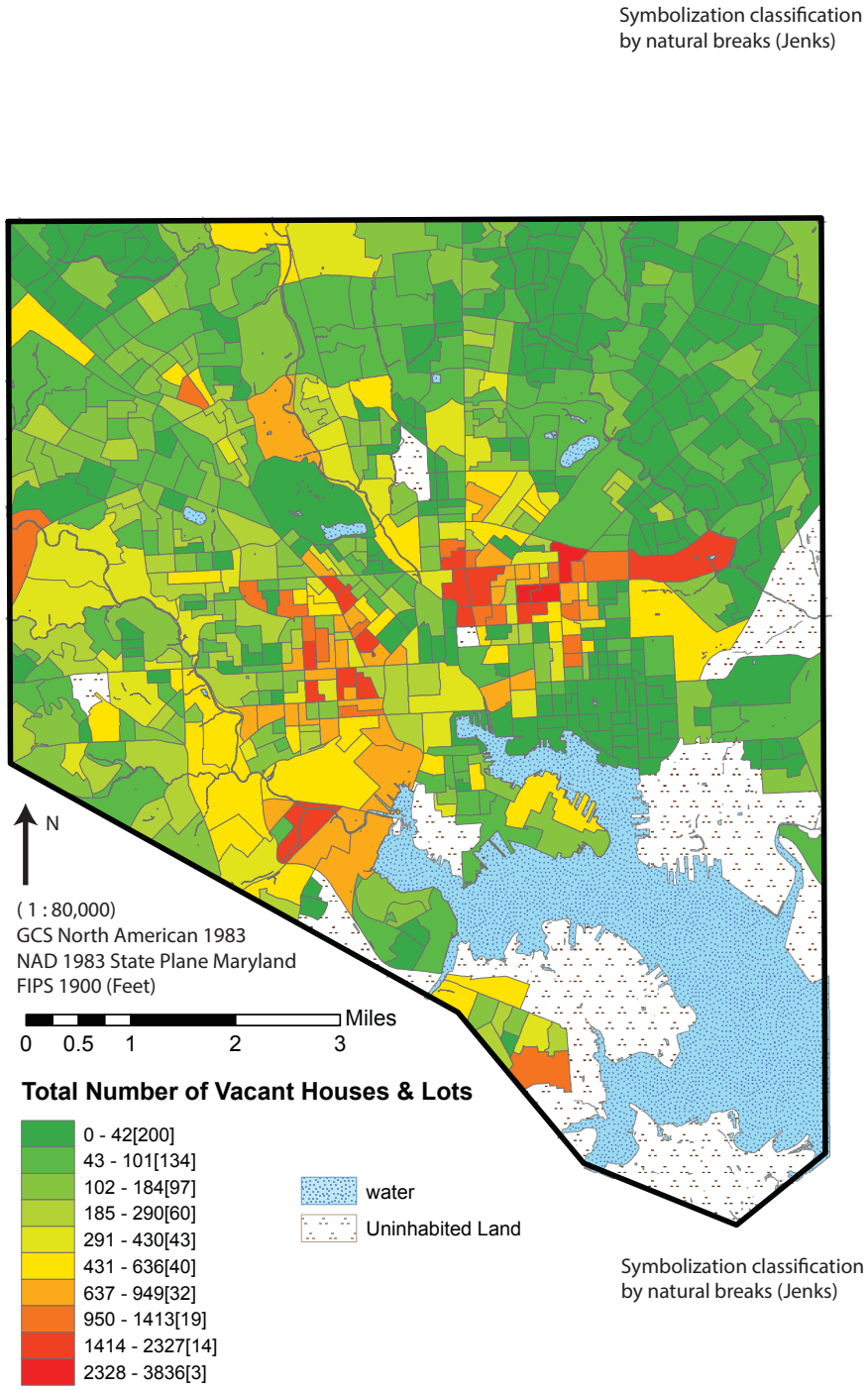

Figure 12. Total vacant houses and lots

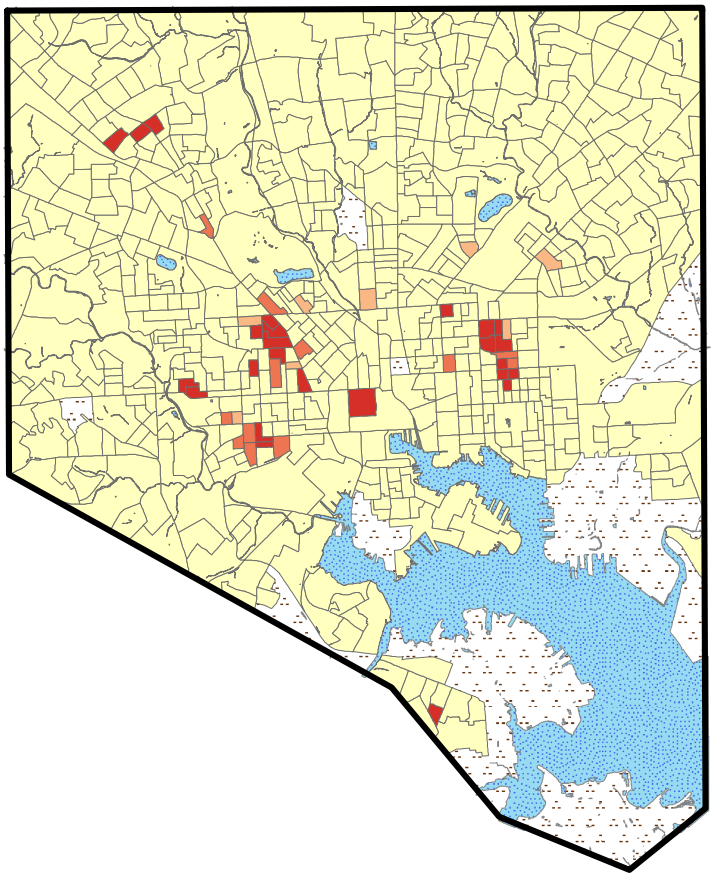

Figure 13. Example raw hot spot results (narcotics arrests 2013)

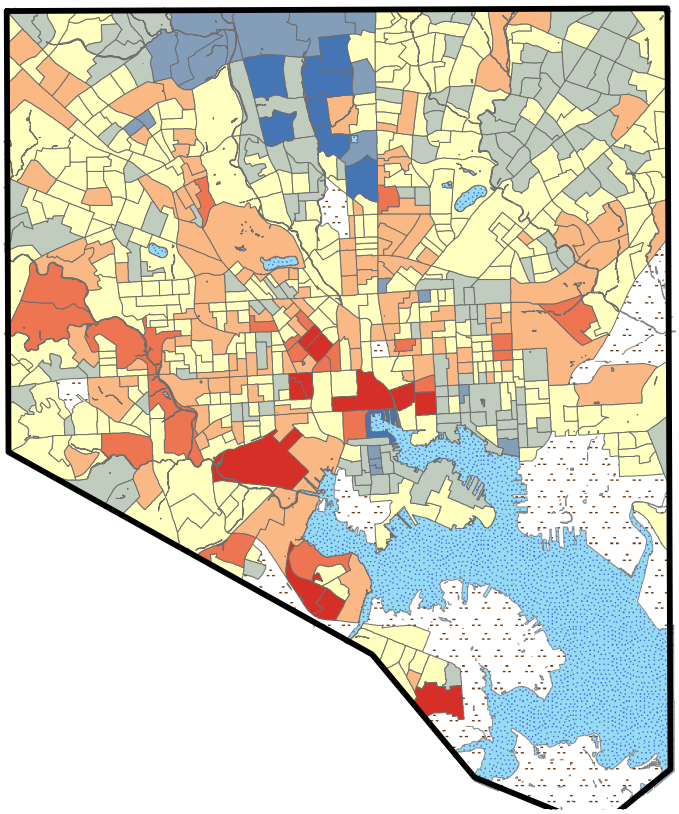

Figure 14. Example of unexpected residual correlation

DISCUSSION

Results Analysis

Based on the three forms of analysis, I was unable to generate strong statistical findings that link crime and/or negative environmental factors to social vulnerability. This can be seen via the error figures including figure 6 (unusual residual plot of crime vs social vulnerability), figure 7 (unusual residual plot of negative environmental factors vs social vulnerability), figure 13 (hot spots of narcotics arrests 13; z-value was greater than 15 suggesting high correlation and likely an error), and figure 14 (negative environmental factor residuals; z-value of greater than 13 suggesting high correlation and likely an error).

Visually, moderately high (0.5 - 0.75) to high (0.75 +) social vulnerability can be observed in downtown, directly west and north west of Martin Luther King Jr. Blvd, following Park Heights Ave, and along the west and southwest side of Gwynns Falls. On the east side, high vulnerability occurs in pockets directly southeast and east of I-83, east of Johns Hopkins Medical Campus, and surrounding east North Ave. Crime hot spots occur in similar areas with multiple types heavily concentrated northeast of Patterson Park, along Pennysylvania Ave, around Pimlico, and within Pratt Monroe. Vacancies occur most heavily near by including Greenmount and Lexington Terrace.

After running spatial autocorrelation tests on residuals of several linear regression models to determine correlation between observed factors, high z-scores such as 11.415, 10.986 and 13.526 suggest unreliable results. These scores resulted when testing social vulnerability against crime normalized by area, by population, and against total vacant parcels respectively. Although these results aren't statistically relevant, visually, levels of high correlation are apparent. Low social vulnerability (>= -1) often occur in low crime and low vacancy areas including Federal Hill, Canton, the wedge of wealth, and Upper Hamilton. On the contrary, Greenmount, Broadway East, Upton and Pratt Monroe show high crime, vacancy and vulnerability (>= .75).

Limitations

Due to several categories of factors, there were a large number of limitations on the project compared to the original proposal. Based on time and statistical experience, several major steps had to be removed in order to complete the project on time. These include studying positive community factors, and a deeper exploration of the spatial relationships between crime as well as environmental influence points. Based on the completed project, there were some data limitations. Aggregated data from statistical areas abstracts away the idea of exact numbers since proportions were assigned to the block-group level. Secondary data used may have been gathered by bias primary sources. For example, arrest data may be spatially skewed towards areas where police travel more often, and data was removed due to the lack of spatial information. There is also the assumption that population distribution is even across the block-group study units. In addition, analysis was restricted to currently quantifiable factors, therefore many data factors in the drug market, such as social connections, the number of unrecognized illegal activities, and the status of homeless populations weren't observed.

CONCLUSION

Project Findings

Baltimore's urban youth social vulnerability has a normal bell curve distribution with a slight skew right towards higher vulnerability. Many social vulnerability indicators can be applied when observing youth, allowing for fairly simple project adjustments and extensions. However, in order to observe accurate variations, it's essential that social vulnerability data be aggregated to no larger than the block-group level. Based on results, attention should be paid to the neighborhoods along east North Ave, Pennsylvania Ave and the Gwynns Falls corridor from Edmonson Ave to Wilkens Ave. These areas, when compared to other areas in the city, have a significantly high vulnerability, especially in relation to their high population and population density. In order to effectively map crime and environmental data, point location is necessary in order to aggregate data. Unusual results seem to be a result from closely overlapping and/or unreliable data. Therefore, correlation between the three realms cannot be accurately assessed.

Future Work

Due to the large extent of this project, the investigation's analysis depth didn't go much deeper than the surface. To complete this project, future studies could observe positive environmental influences. Future studies could also dive deeper by examining more variables, and looking at their relationships. For example, solely studying crime could reveal information about what types of crime are committed near each other, and what types of crimes are committed by different age groups. Since environmental data is both in point and polygon form, further exploration would likely aggregate data down to the block level and could explain things such as if crime happens in active dense areas, on residential edges near vacants, or other land types.

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