Stadia as risky places: The importance of context

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Leisure and fun

Large gatherings

Team Rivalry

Sports, concerts & others

After game celebration

- Financial services
- Construction
- Environment
- Social engagement
- Management
- Marketing
- Technical
- Insurance
- Business (e.g., Food & Drinks)

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- **Crime occurrences**

Crime patterns associated with sporting events?

Time difference for fans:

Local fans vs global fans vs **fluid fans** (new term in the sports industry)

Agenda

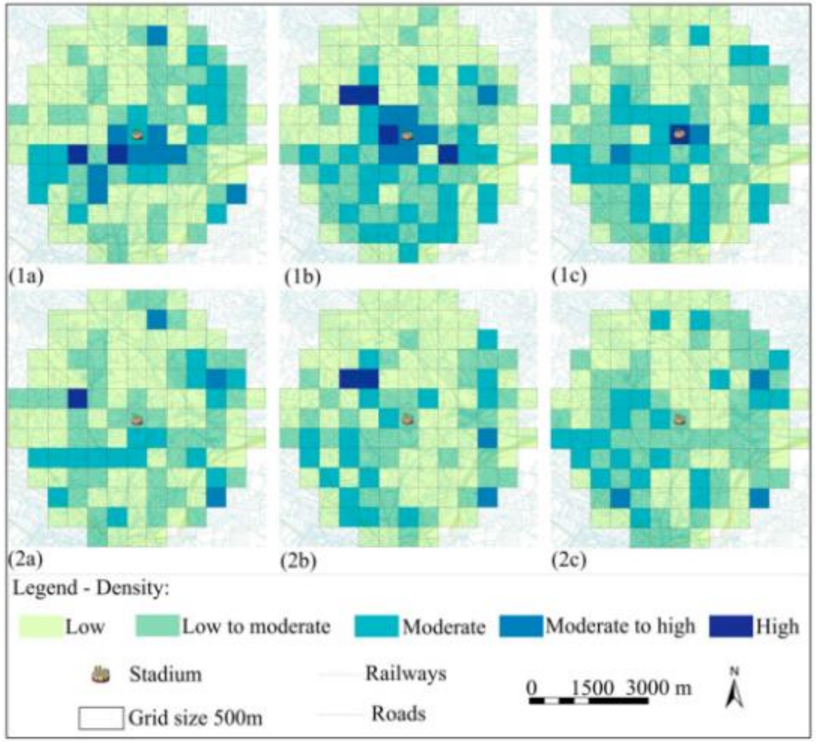
- Stadia (or stadiums) in relationship with crime
- Crime – sporting events – social media
    - Understanding patterns
    - Prediction and biases
- New technologies, modern applications – adapting theory?

Literature

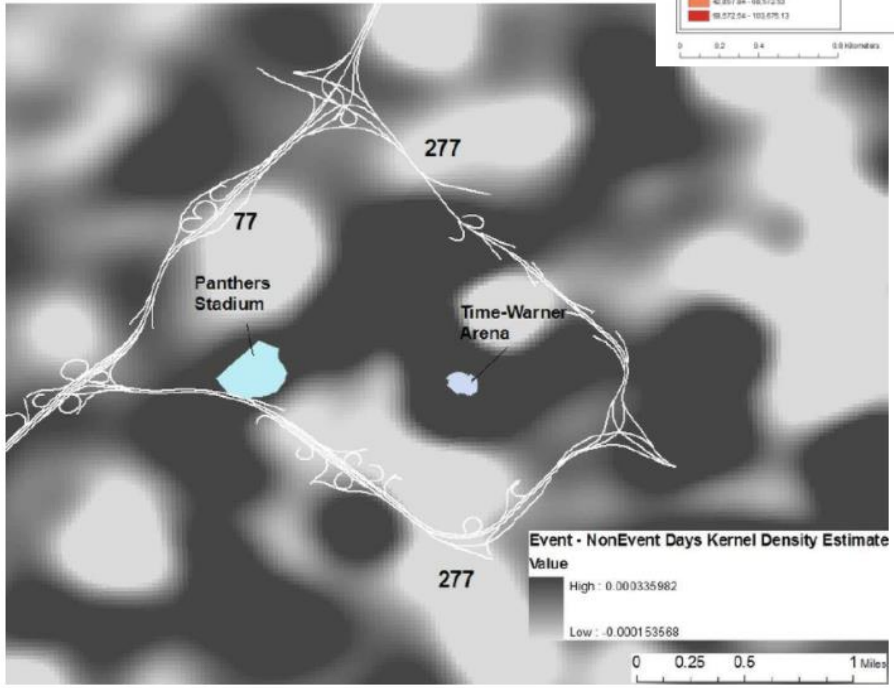
Game days
vs
comparison days

Ristea et al 2018

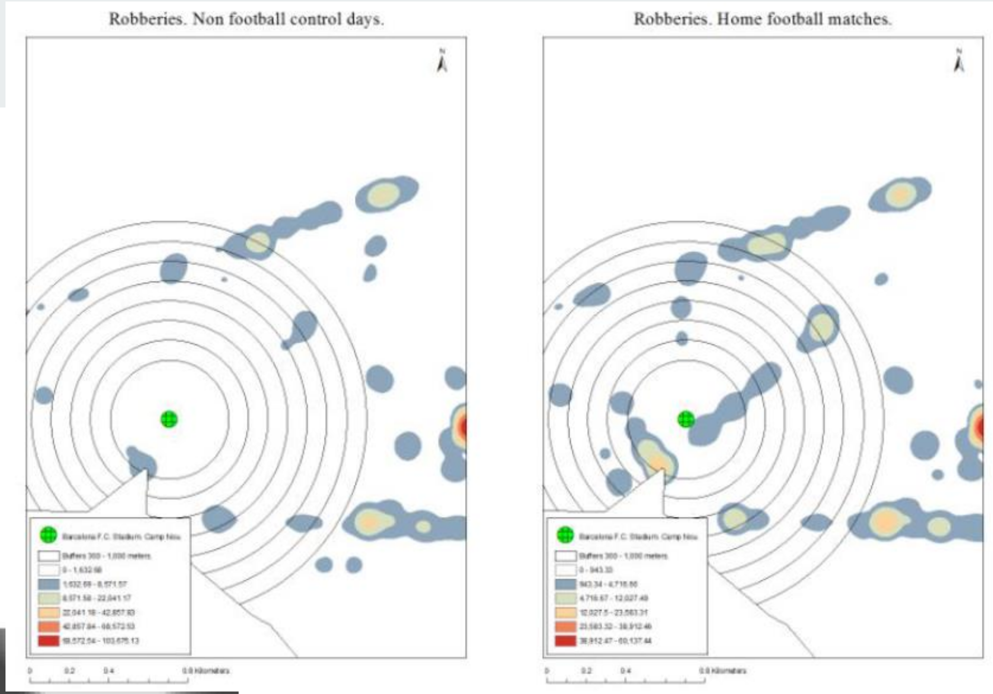
Figure 7. Density for each crime type (**a**) criminal damage, (**b**) theft and handling, and (**c**) violence against the person; (**1**) match days, (**2**) comparison days (using the Natural Jenks classification method).



Billings & Depken 2012



Kernel Density Estimator Depicting Distribution of Difference in Total Reported Crime in Charlotte NC on Event Days and Non-event Days from January 1, 2005 through December 31, 2008

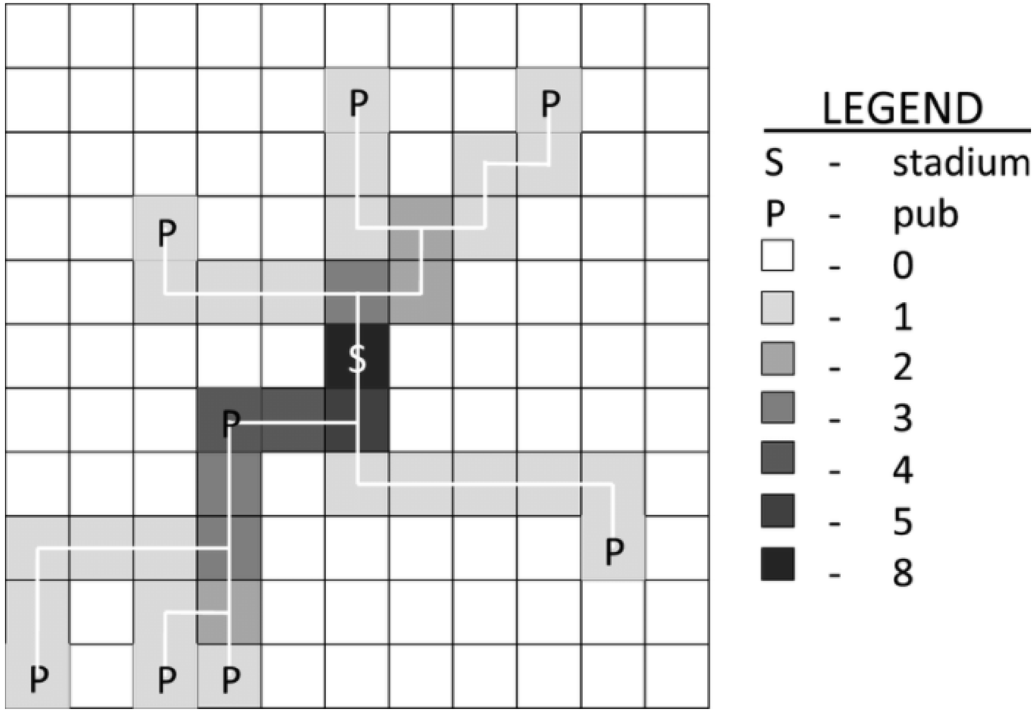


Struse and Montolio (2014)

Literature

Game days
vs
comparison days

Kurland & Johnson 2019



Example of the shortest network distance (SND) approach to estimating movement potential between "micro-facilities" (pubs in this example) and the relevant stadium

Klick & MacDonald 2021

Table 4 Effect of extra innings on assaults

Before and After Xfinity Live! Opens			
	Baseline extra innings effect	Additional pre-2012 extra innings effect	Observations
Extra innings*Home game*CBP coefficient	0.04*** (0.0004)	−0.05*** (0.0006)	2,029,384
Permutation *p* (t stat) 1-sided	<0.028	<0.022	
Permutation *p* (t stat) 2-sided	<0.064	<0.047	

Menaker et al 2019

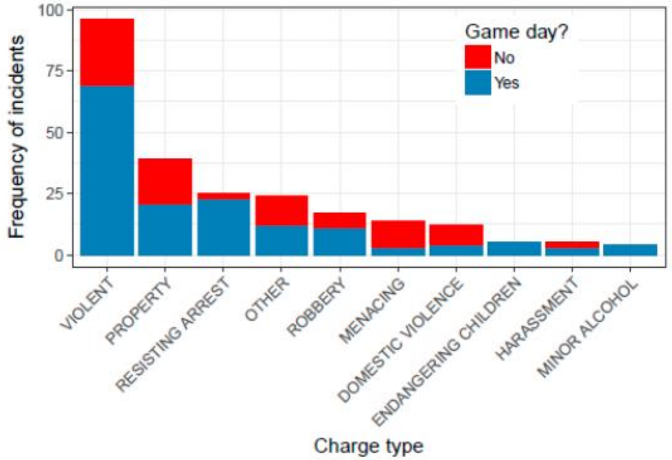
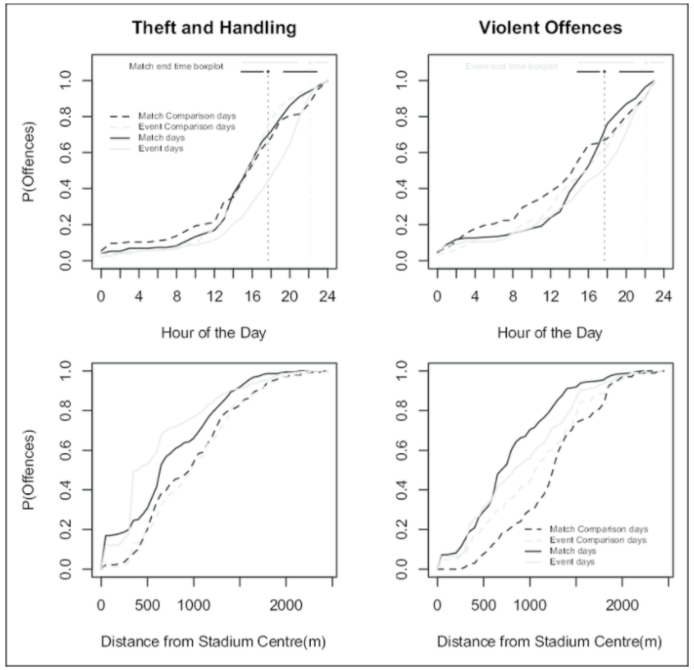


Figure 1. Frequency of 11 types of charges reported within 800 m of two professional sports venues in Cleveland, OH, January 2009 – February 2014. Charge frequency generally increased on game days (table 1) although the effect was limited to specific charges (figure 2).

Literature

Game days
vs
comparison days

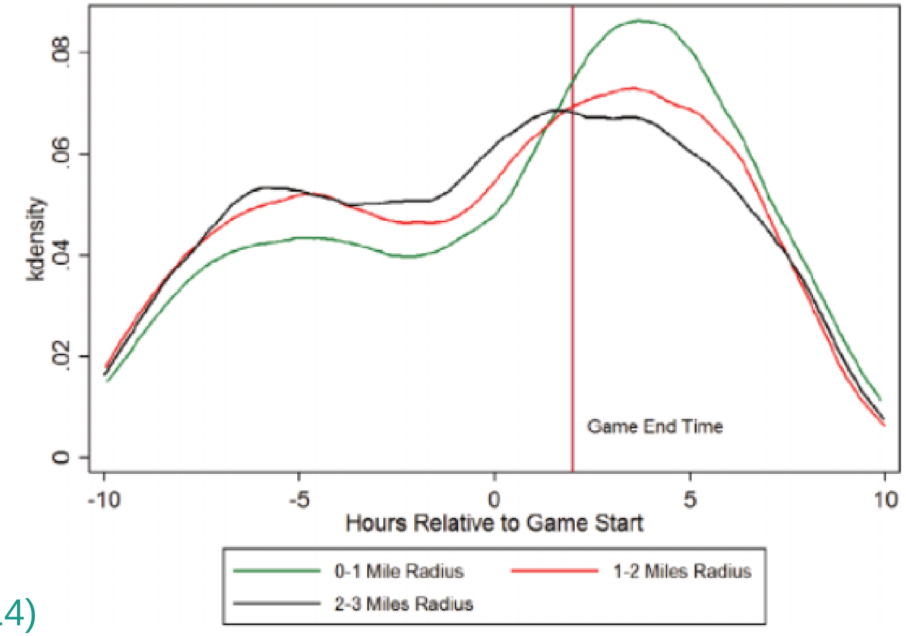
Kurland, Johnson & Tilly 2019



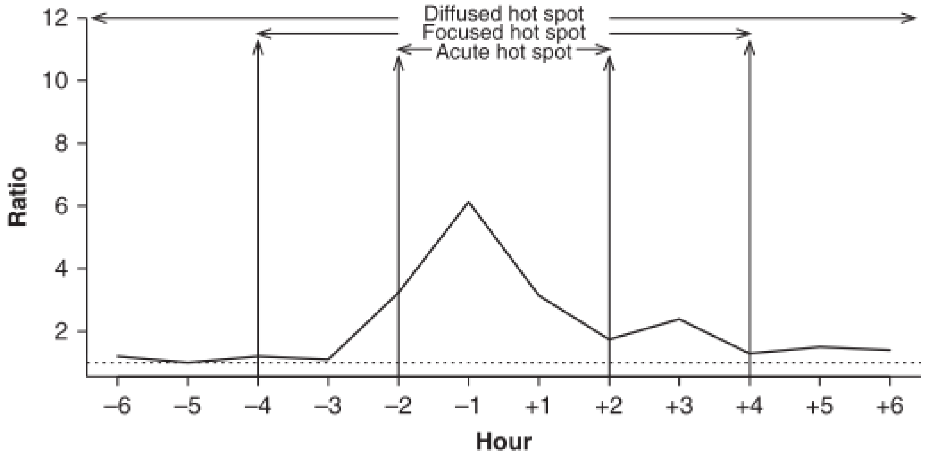
The empirical cumulative distribution function (ECDF) for the two categories of crime (and boxplots for the end times of matches and events).

Ge, Barbieri & Schneider 2020

Density Distribution of Property Crimes.



Kurland, Tilley and Johnson (2014)

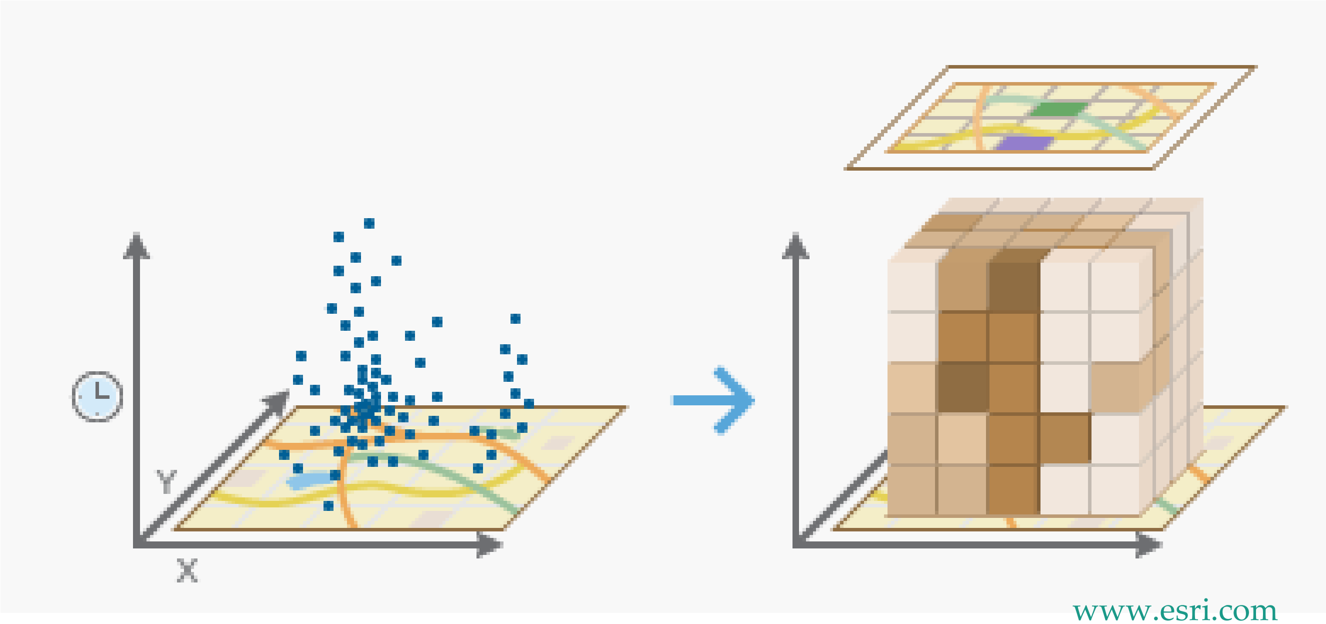


Context

- Case studies for specific locations (Country/State specific)
- Built environment
- Type of fans
- Transportation mode - infrastructure
- Cultural differences
- Event characteristics: rival teams, friendly game, championship, timeline

Spatiotemporal

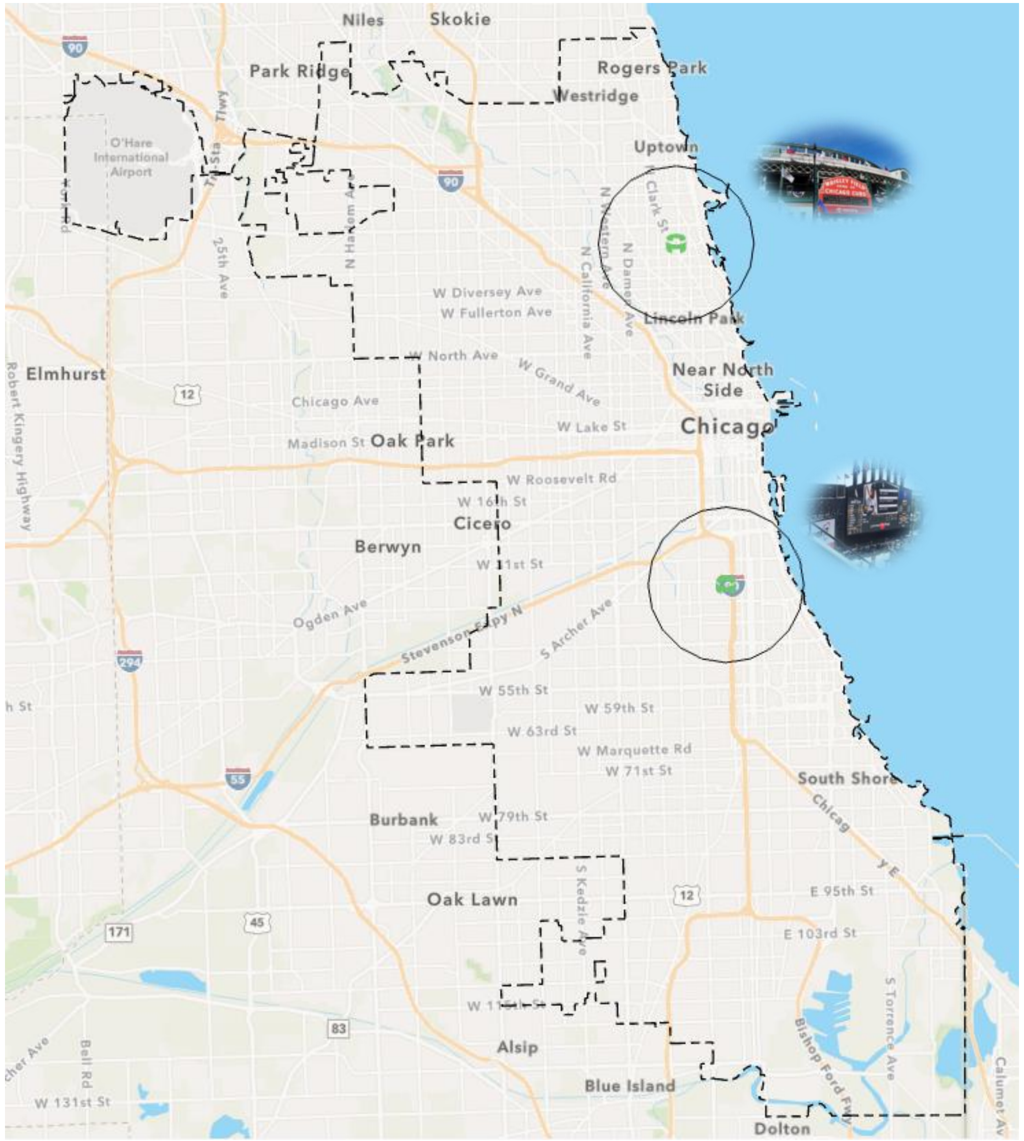
Space-time cube



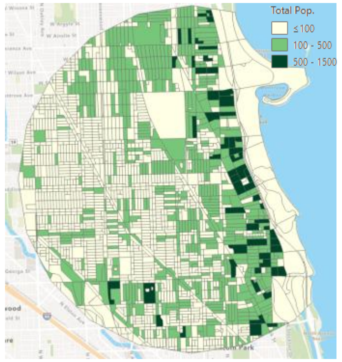
www.esri.com

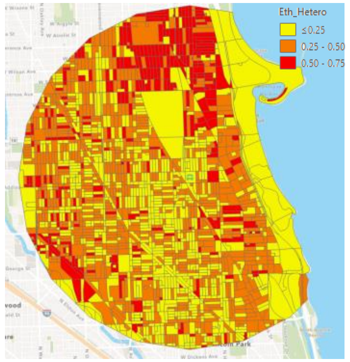
Two baseball stadia in Chicago

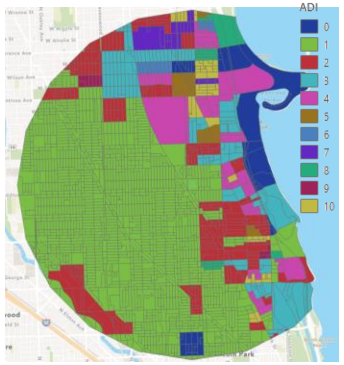
- Crime data: 2017 – 2019
- Methodology: game vs comparison days
- Spatial Unit: Census Block
- Temporal Unit: 2h before the game and 2h after the game (considering a game of 3h)

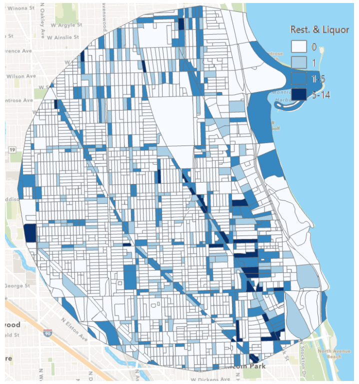


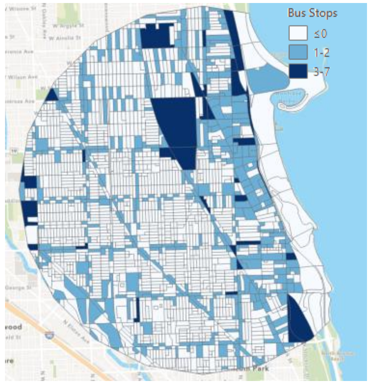
Two baseball stadia in Chicago

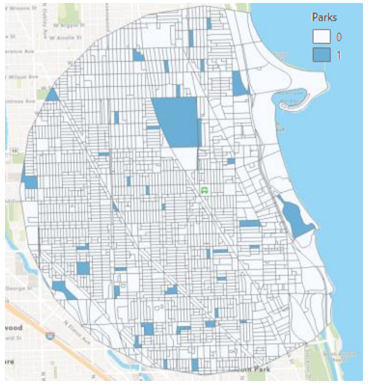












Total Population

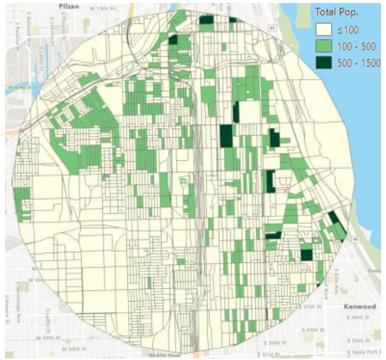
Ethnic Heterogeneity

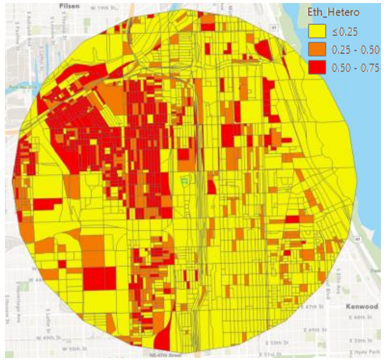
Area Deprivation Index (ADI)

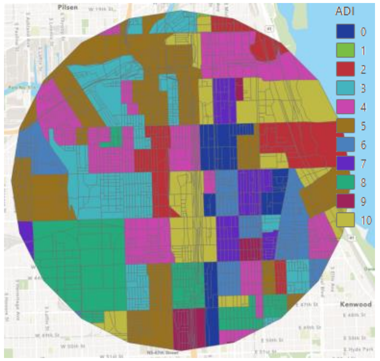
Restaurants and Liquor Stores

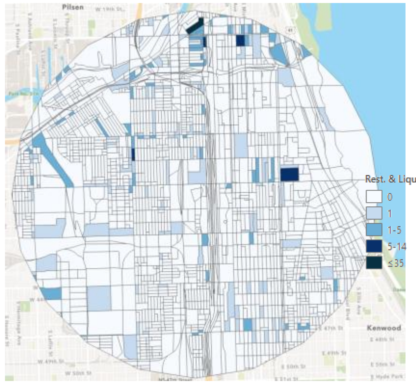
Bus Stops

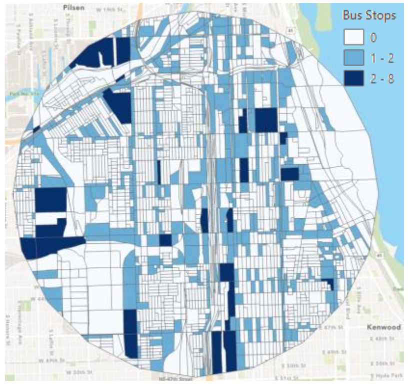
Parks

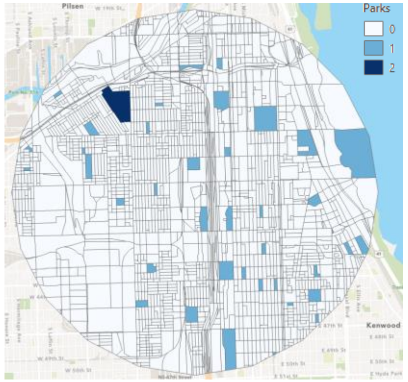








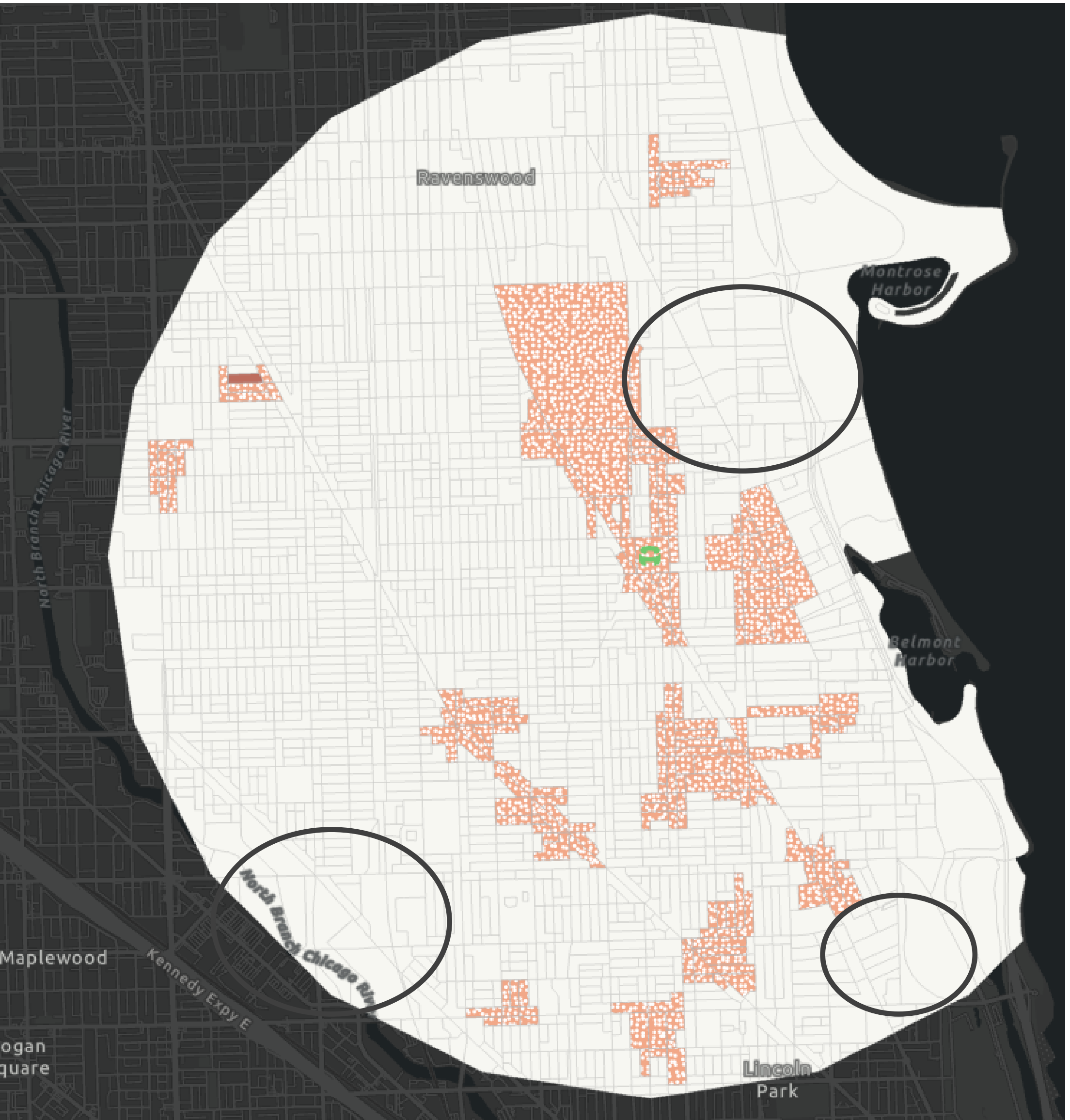




* Not published yet

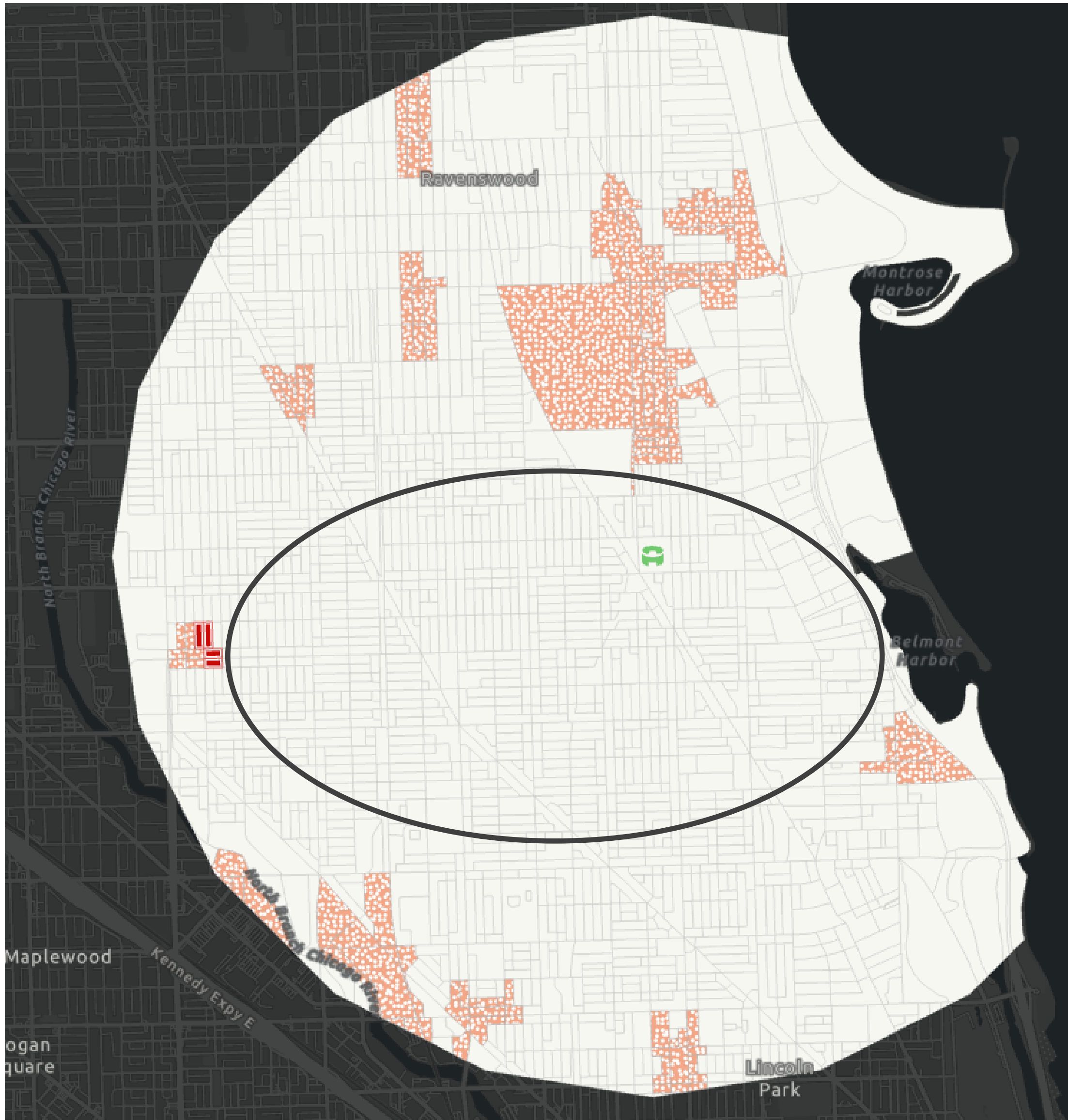
Burglary, Robbery, Vehicle Theft, Assault, Theft – Wrigley Field

Game



PATTERN
- New Hot Spot
- Consecutive Hot Spot
- Intensifying Hot Spot
- Persistent Hot Spot
- Diminishing Hot Spot
- Sporadic Hot Spot
- Oscillating Hot Spot
- Historical Hot Spot
- New Cold Spot
- Consecutive Cold Spot
- Intensifying Cold Spot
- Persistent Cold Spot
- Diminishing Cold Spot
- Sporadic Cold Spot
- Oscillating Cold Spot
- Historical Cold Spot
- No Pattern Detected

Comparison



Robbery

Game

PATTERN

- New Hot Spot
- Consecutive Hot Spot
- Intensifying Hot Spot
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- Sporadic Hot Spot
- Oscillating Hot Spot
- Historical Hot Spot
- New Cold Spot
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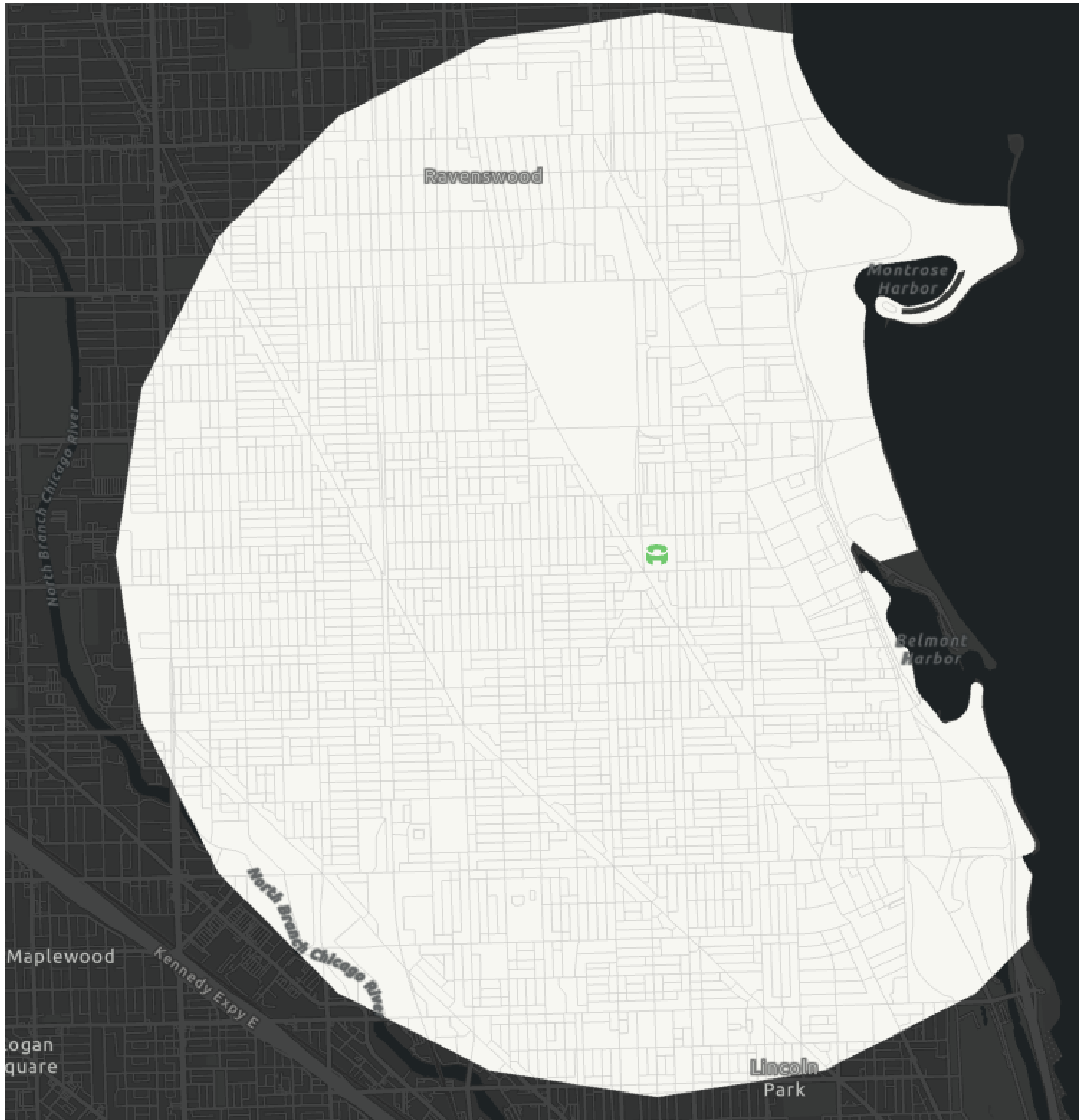
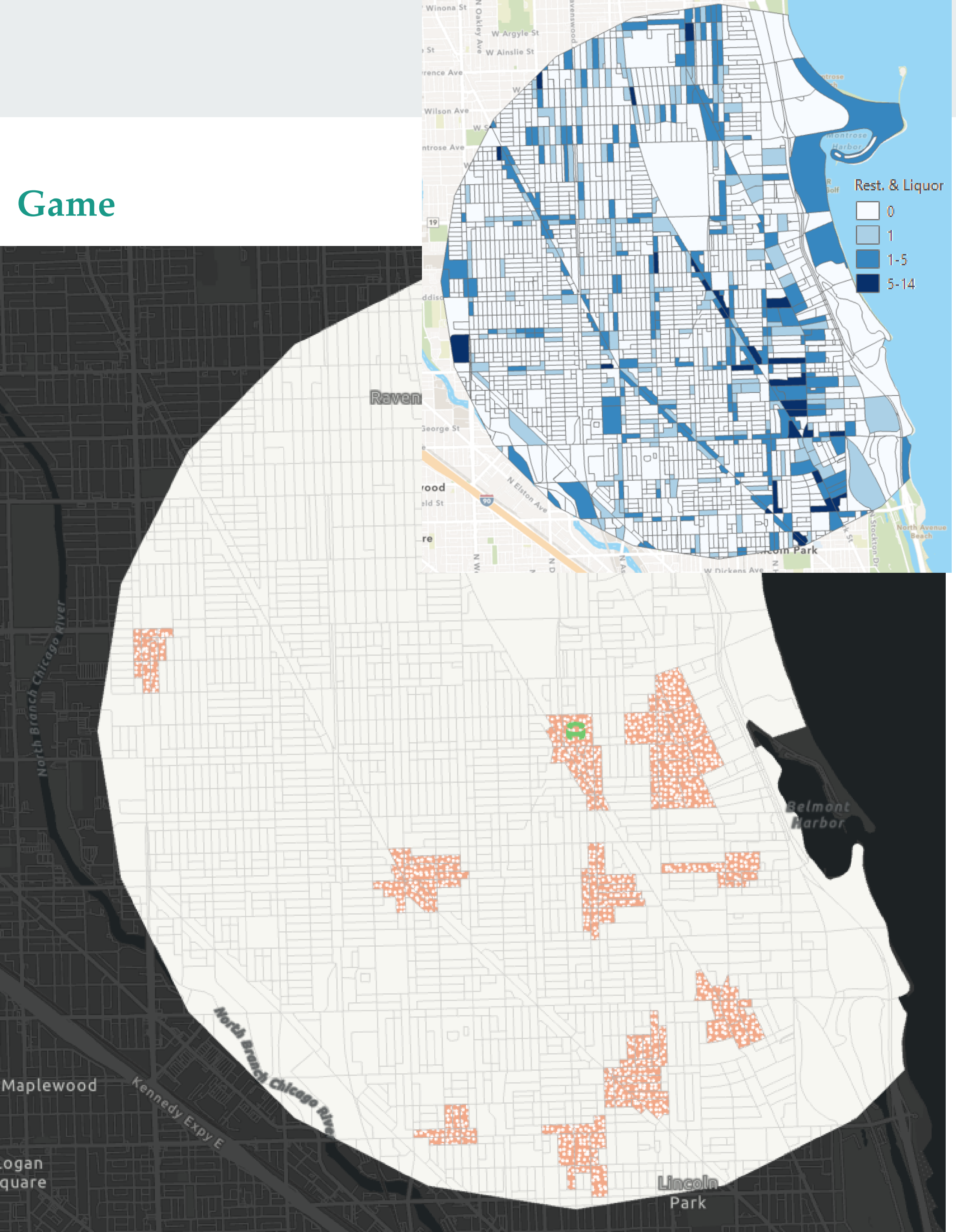
Comparison



Theft

Game



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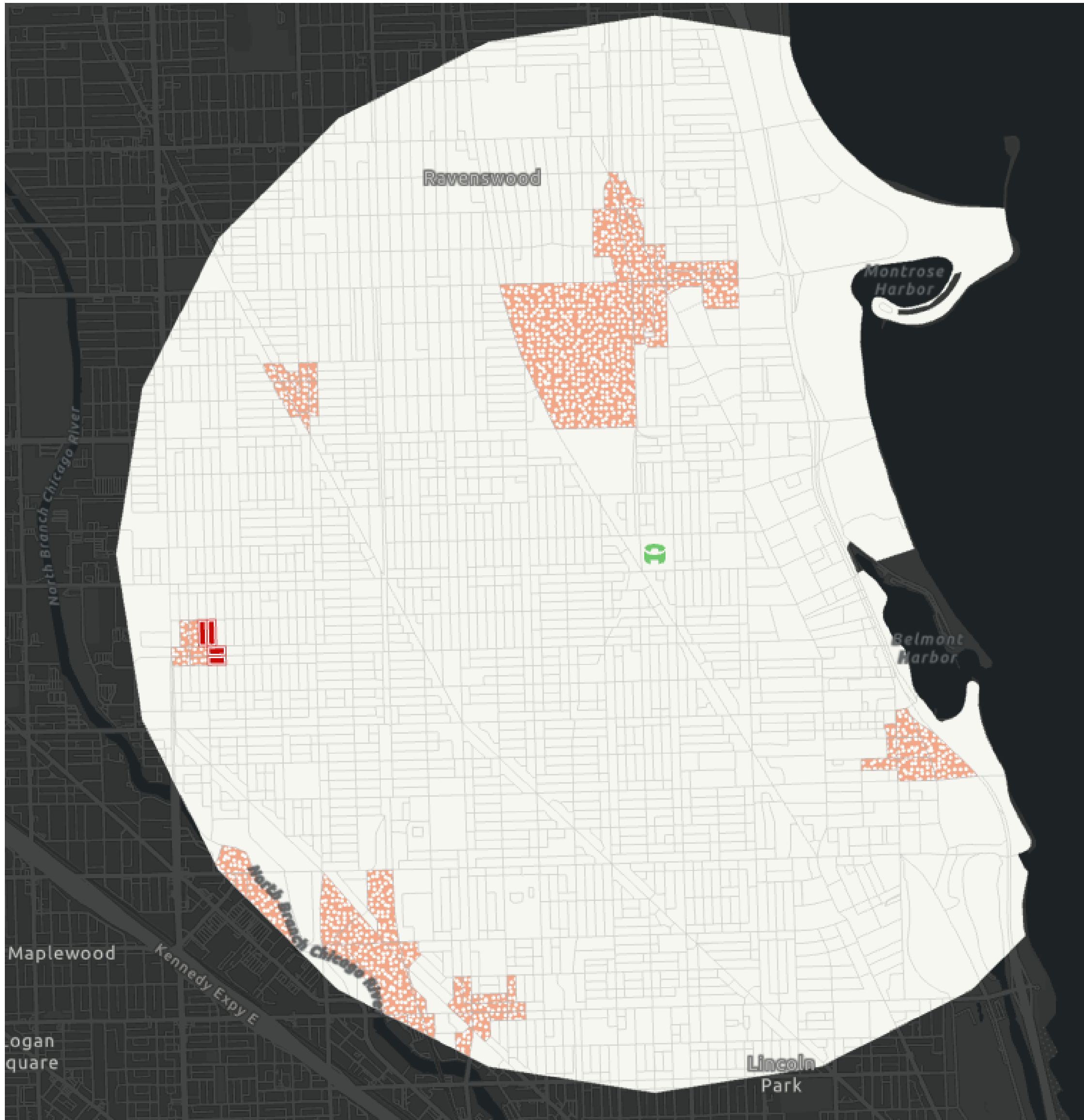

Burglary, Robbery, Vehicle Theft, Assault, Theft – Guaranteed Field

Game

Comparison

PATTERN
- New Hot Spot
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- Diminishing Hot Spot
- Sporadic Hot Spot
- Oscillating Hot Spot
- Historical Hot Spot
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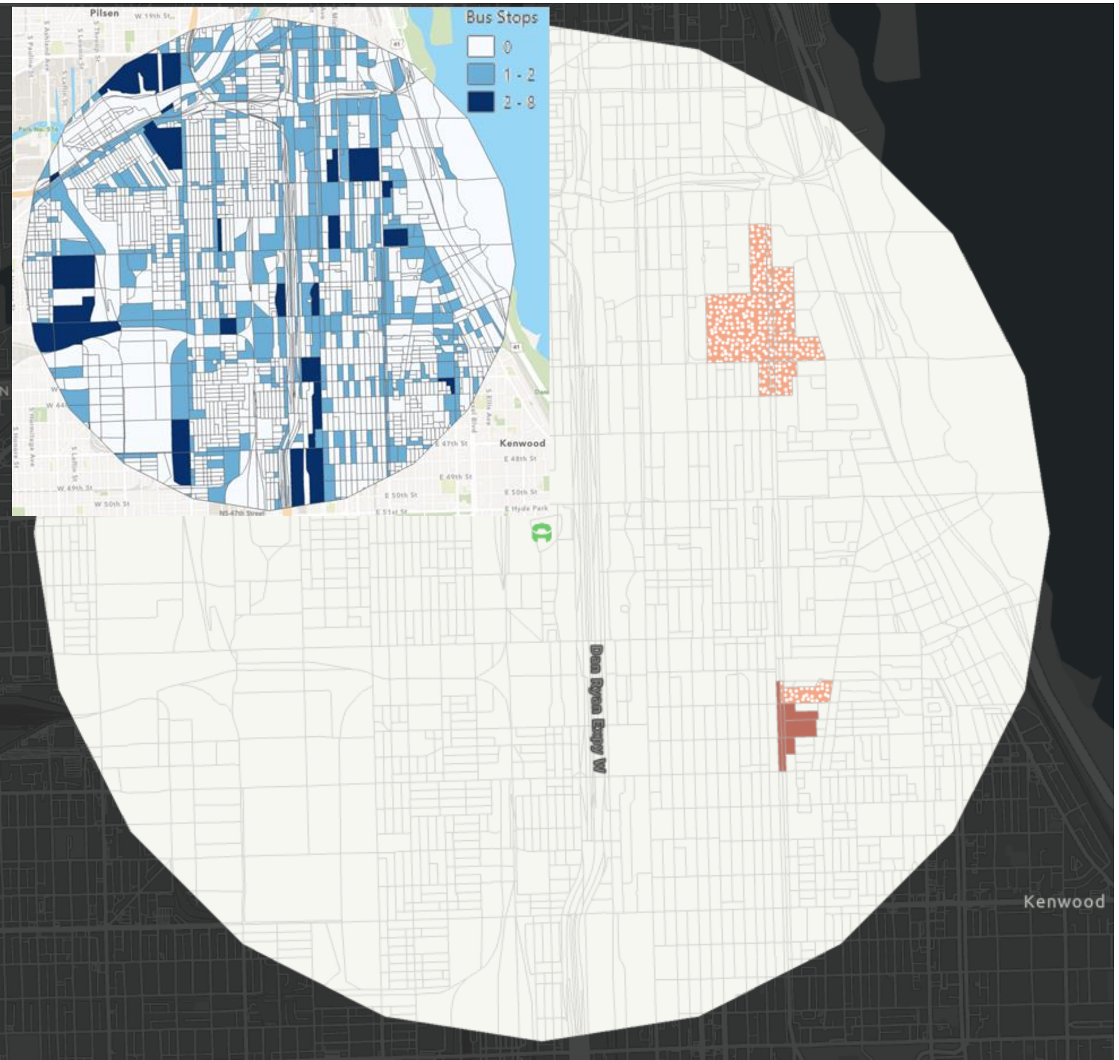
Robbery

Game



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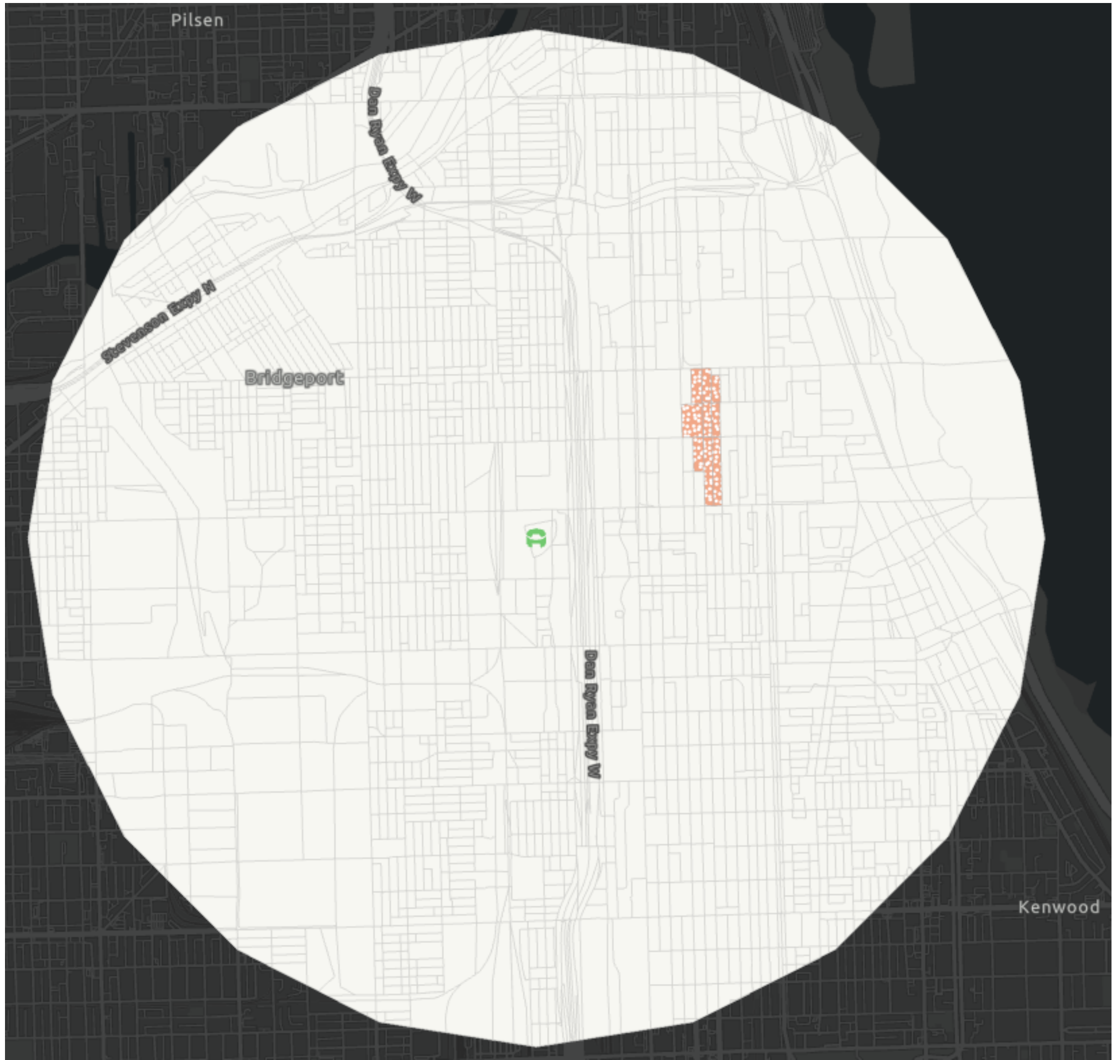
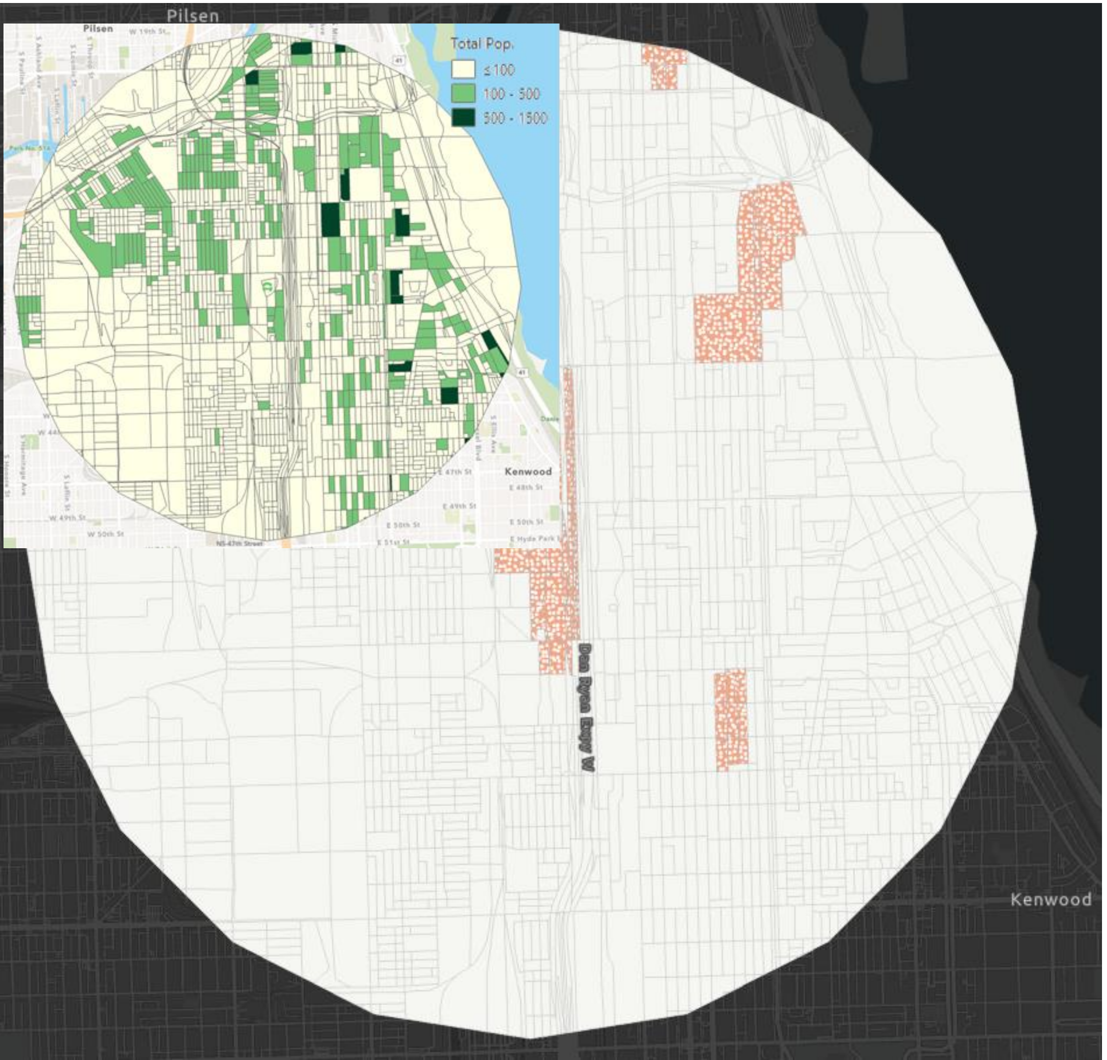


Theft

Game



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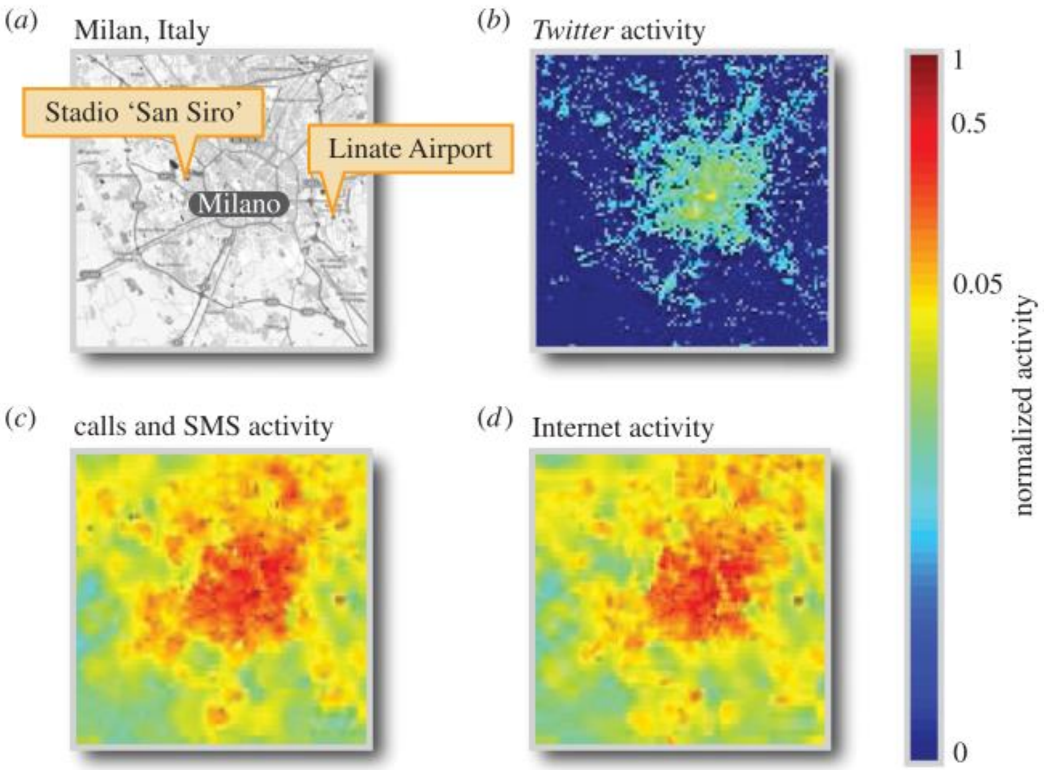
Comparison

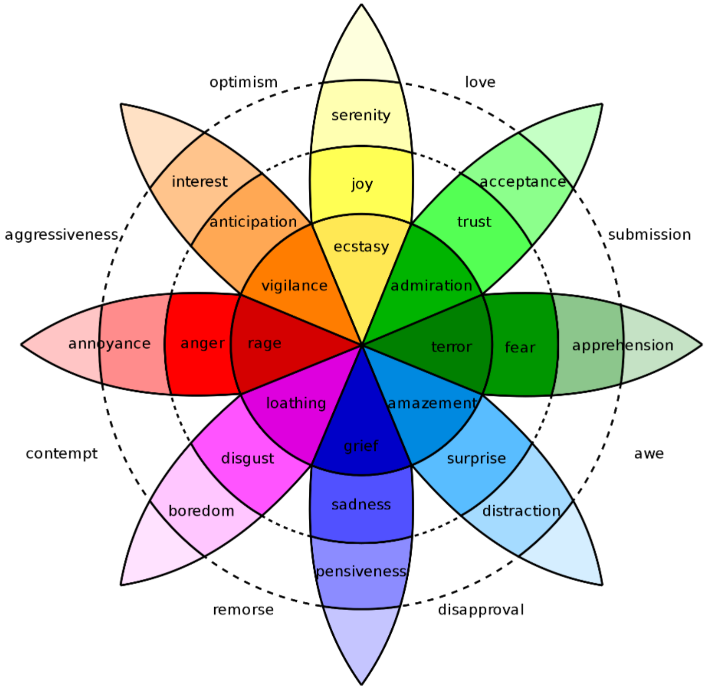
Crime – Sporting Events – Social Media



Botta, Moat and Preis (2015)

Social Media related features

- **Sentiment analysis**
  - polarity;
  - emotions (feelings).
- **Topic modeling extraction**
  - sporting events;
  - violent topics.
- **Population at crime risk**
  - ambient population;
  - complement residential population.
- **Crime-related tweets**
  - lexicon based;
  - mixed approaches.

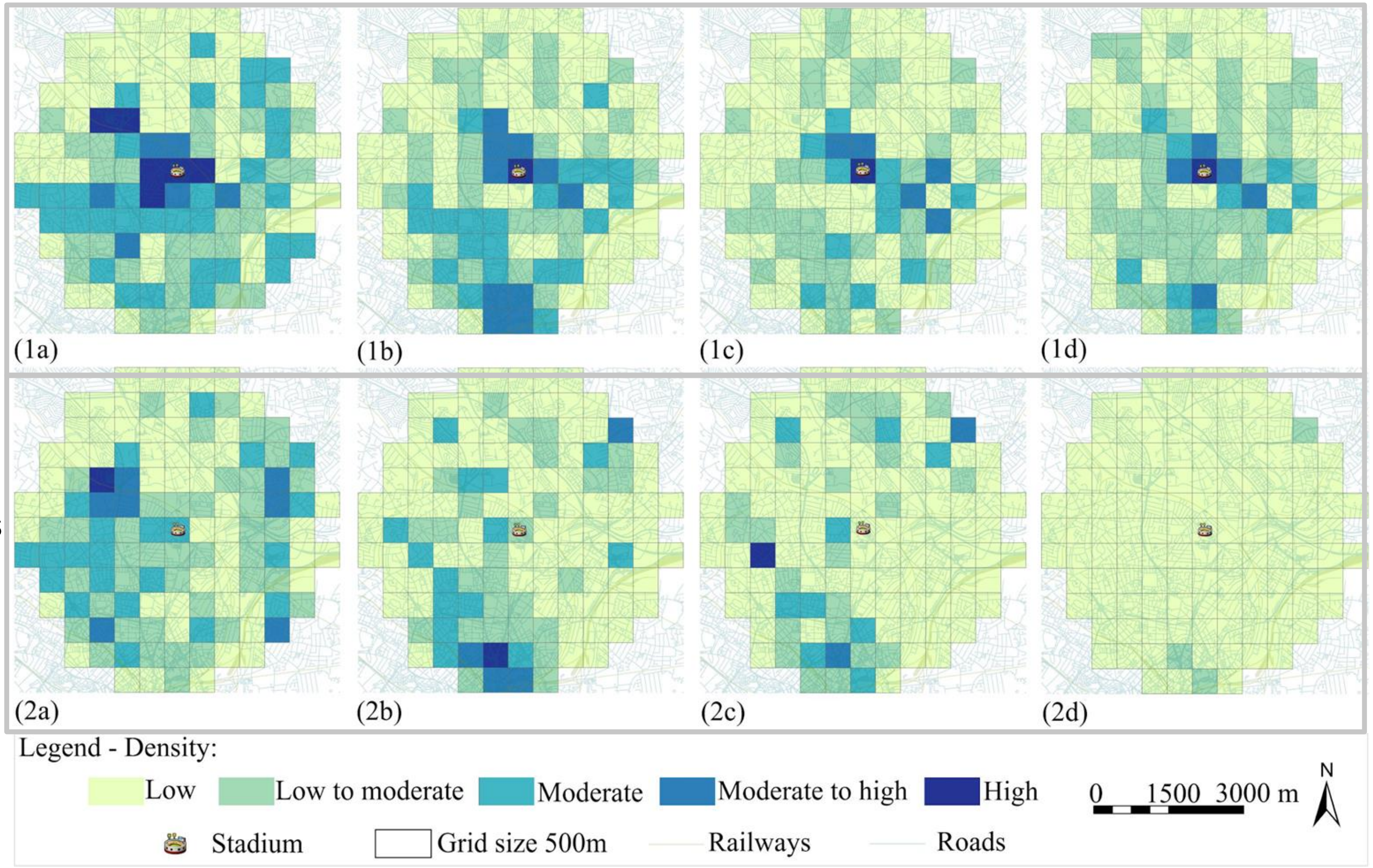


Plutchick’s wheel of emotions

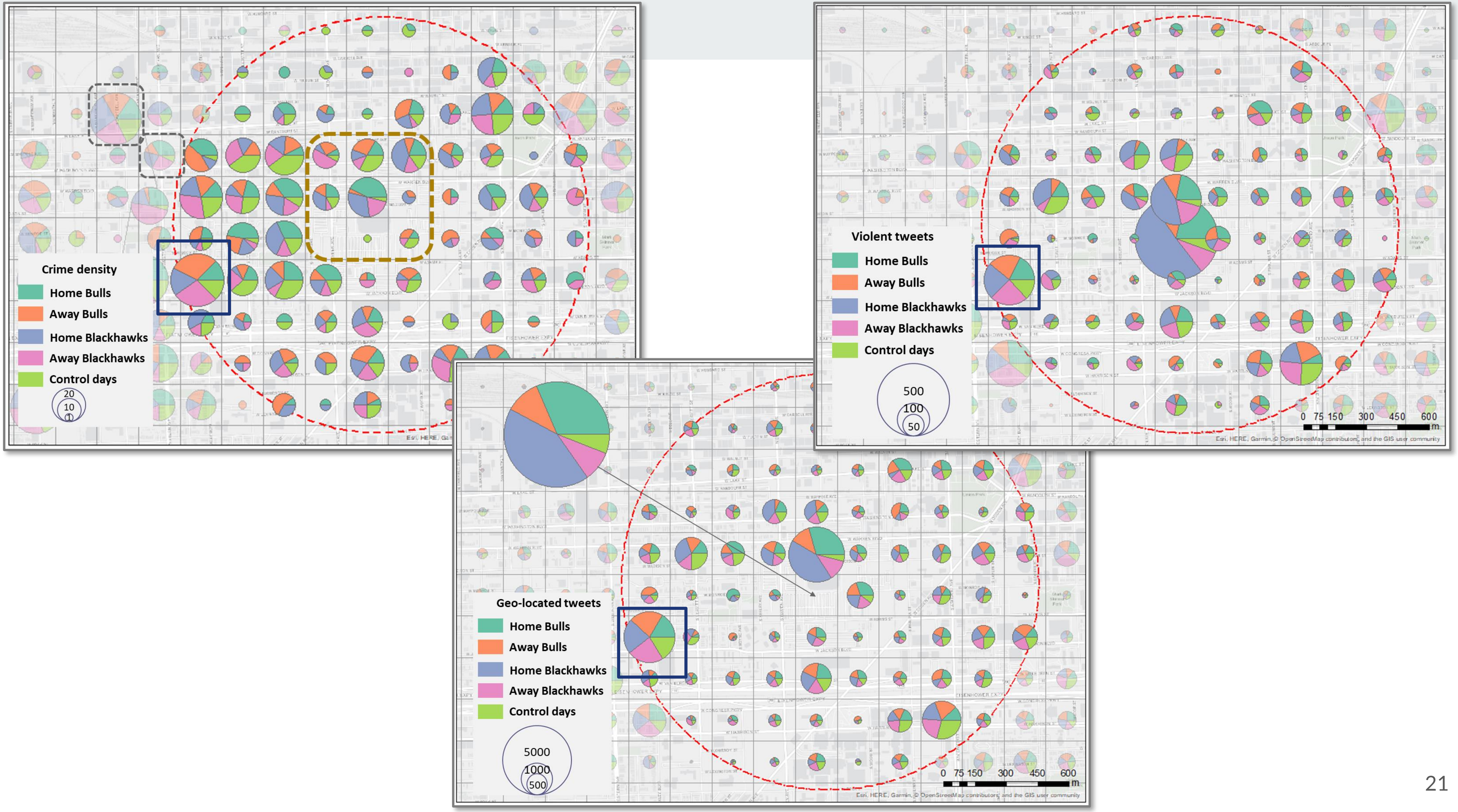
Plutchik (2001)

Game days

Control days



Density maps Aston Villa stadium (a) amalgamated crimes, (b) geotagged tweets, (c) violent tweets, and (d) football-related tweets


Crime density
Home Bulls
Away Bulls
Home Blackhawks
Away Blackhawks
Control days
20
10
1
Violent tweets
Home Bulls
Away Bulls
Home Blackhawks
Away Blackhawks
Control days
500
100
50
0 75 150 300 450 600 m
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community
Geo-located tweets
Home Bulls
Away Bulls
Home Blackhawks
Away Blackhawks
Control days
5000
1000
500
0 75 150 300 450 600 m
Esri, HERE, Garmin, © OpenStreetMap contributors, and the GIS user community

Notes

- **geometry of crime** changes during sporting (home) game days
- **place composition** is highly connected with criminal behavior
- **positive correlation** between crimes and tweets on game days
- various **sporting events at a venue** -> various crime types increase
- **similar temporal patterns**
- **shifted vs stable** crime and social media hot spots – stadium proximity
- correlation **crime-related tweets** and **attitudes on disorder**.

Prediction

Systematic Review | Open Access | Published: 27 May 2020

A systematic review on spatial crime forecasting

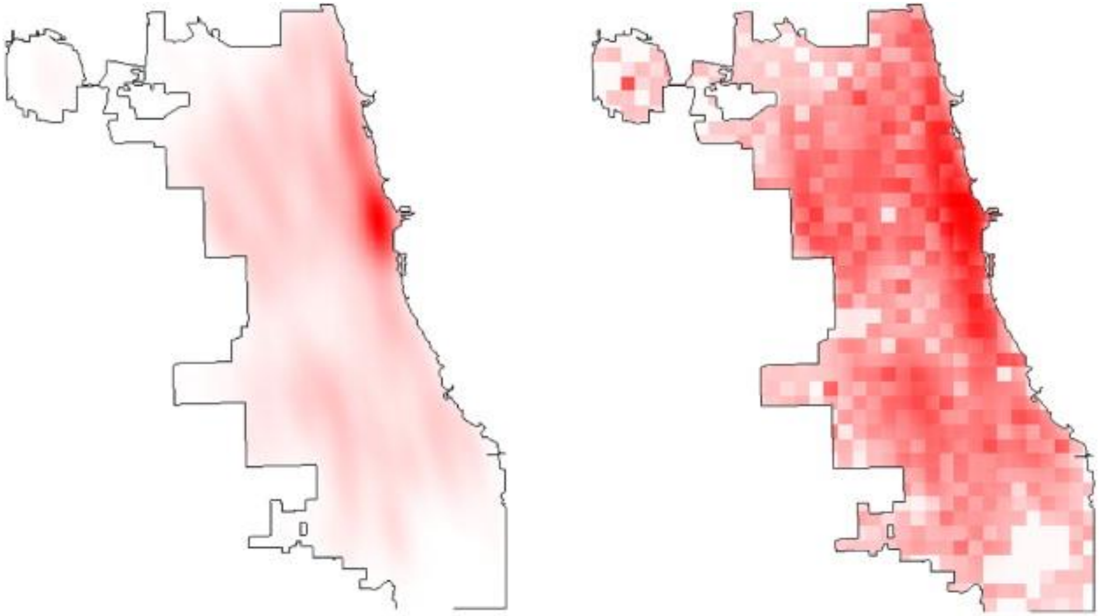
Ourania Kounadi, Alina Ristea, Adelson Araujo Jr. & Michael Leitner

Crime Science **9**, Article number: 7 (2020) | Cite this article

6523 Accesses | **7** Citations | **11** Altmetric | Metrics

Prediction: base + dynamic features in space-time

Gerber (2014)

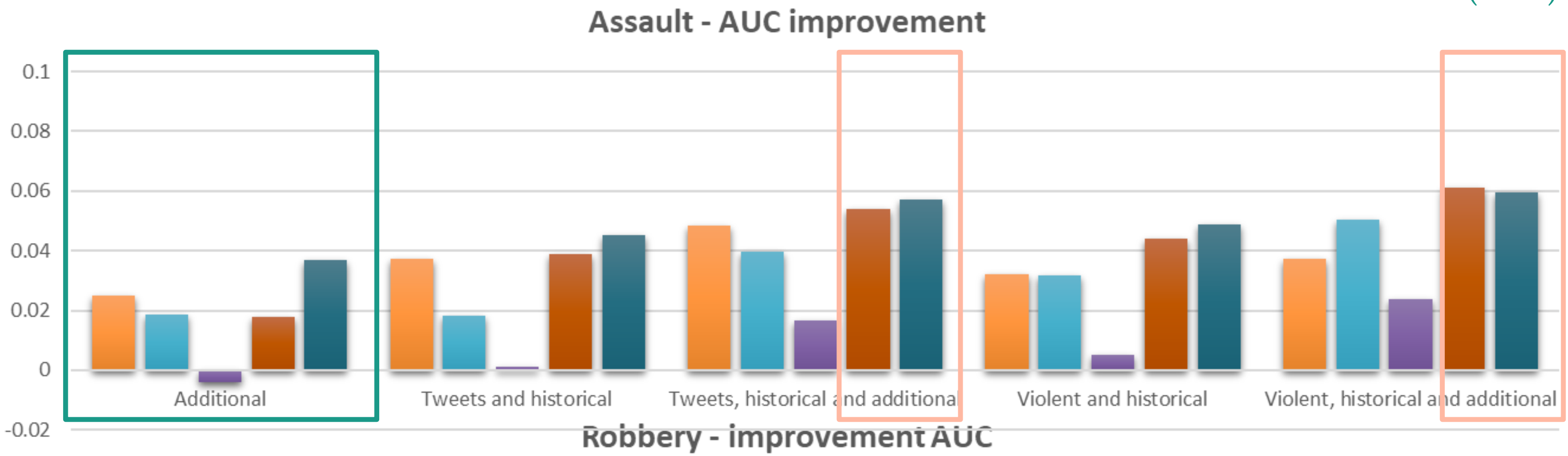


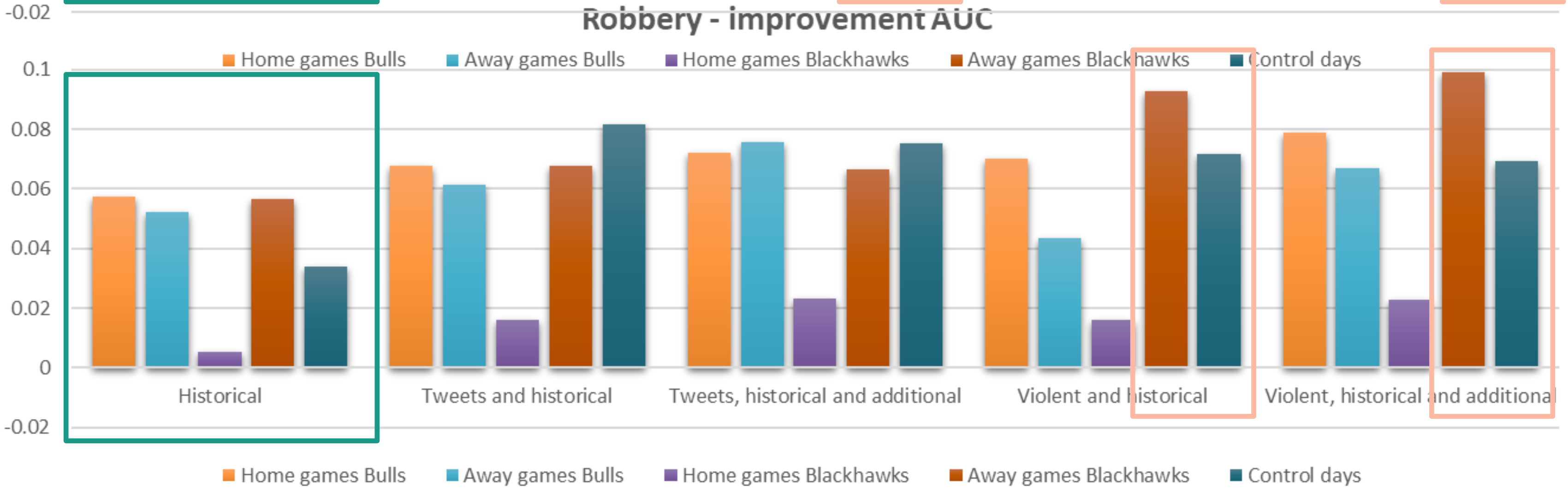
(a) Predicted threat surface using only the KDE feature.

(b) Predicted threat surface using the KDE feature and the Twitter features.

Prediction crime types

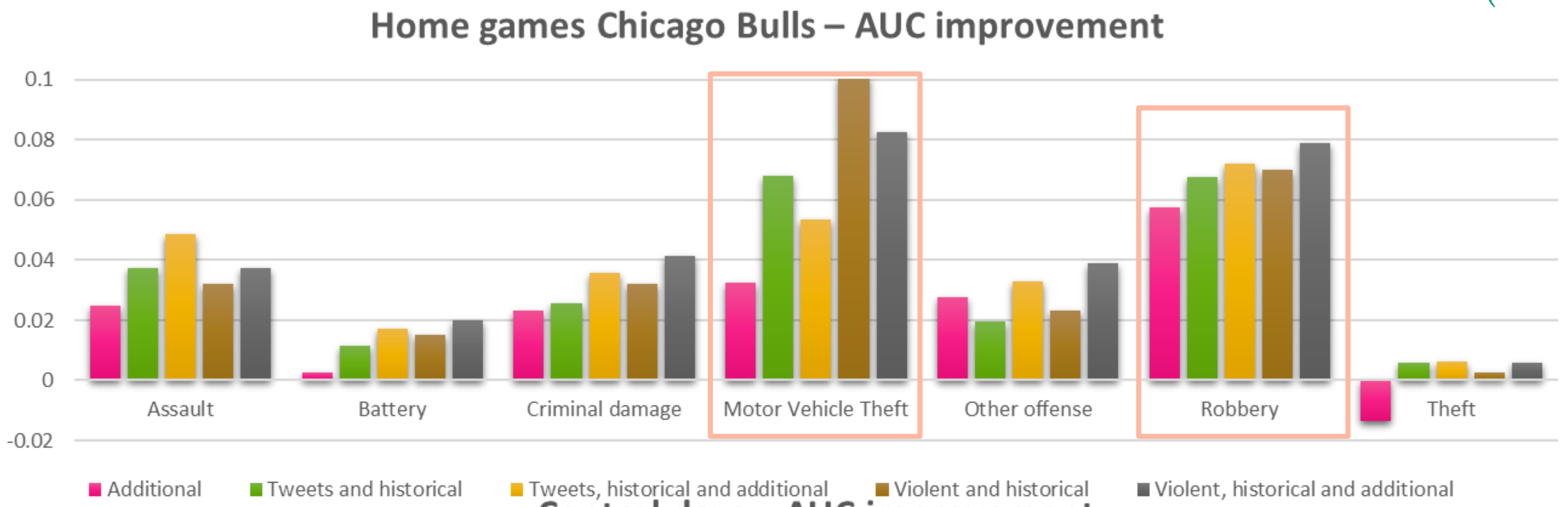
Ristea et al (2020)

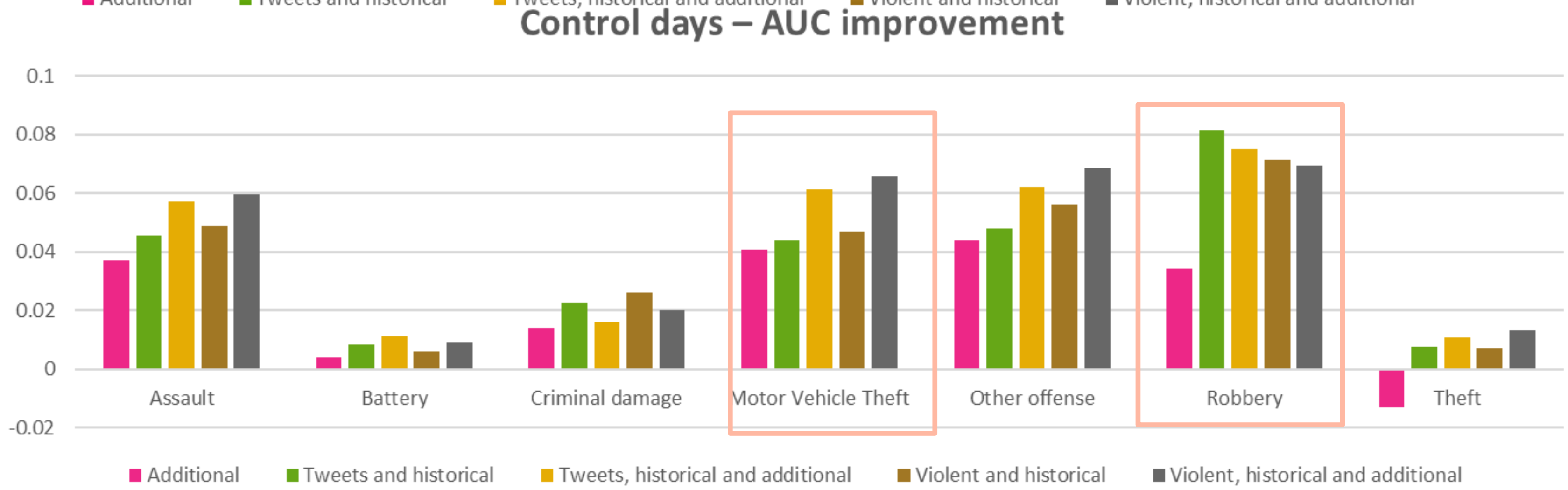




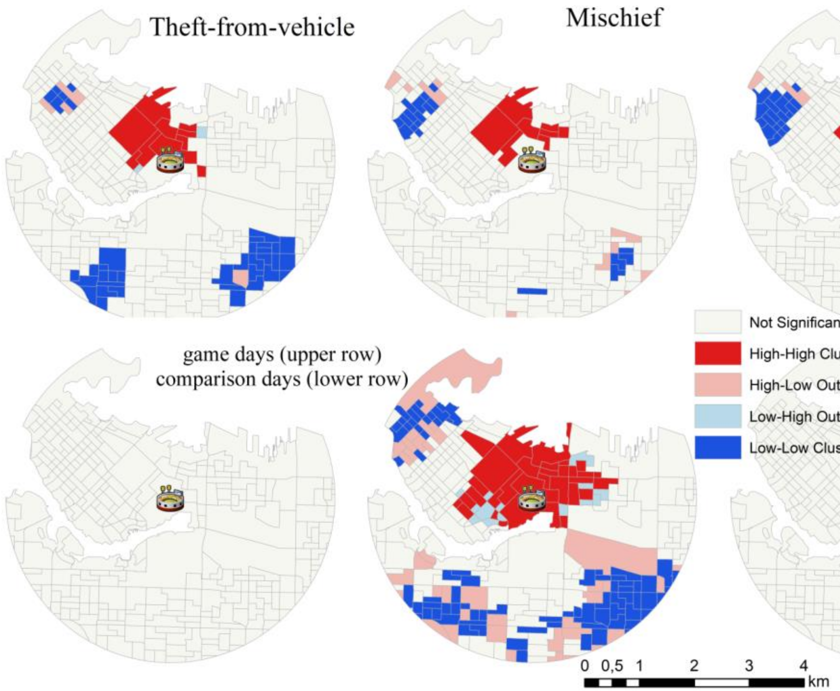
Prediction game days vs control days

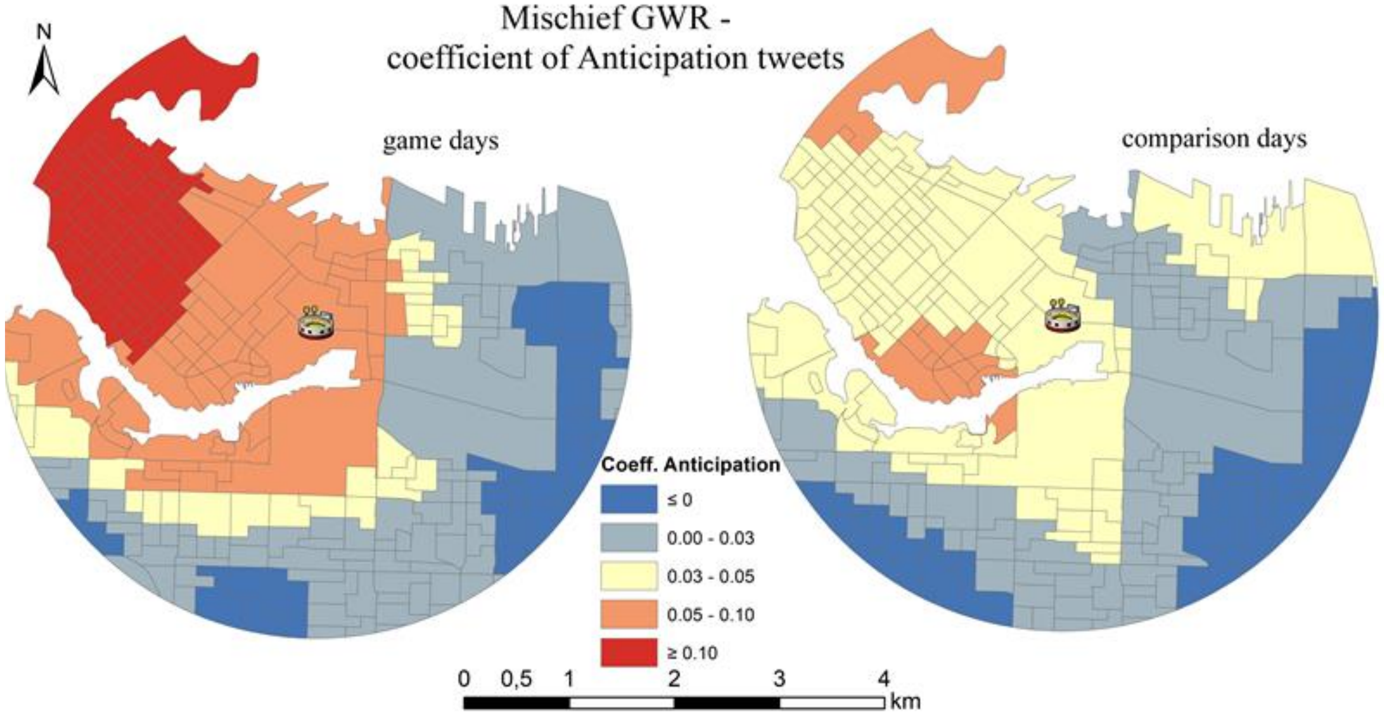
Ristea et al (2020)





Ristea et al (2018)





3km area around Rogers Arena, Canucks team (hockey), Vancouver, Canada

Mischief Adj. R^2	Game days GWR	Comparison days GWR
Tweets	0,83	0,78
Anticip.	0,85	0,79
Surprise	0,82	0,78
Trust	0,85	0,78
Positive	0,84	0,79

Data quality

- data quality: social media bias (age, gender, semantics, study area etc) and geo-location information;
- crime data quality and geo-privacy aggregation;
- data aggregation in space and time: Modifiable Areal Unit Problem (MAUP) and temporal unit selection;
- data sparsity: negative-positive ratio in prediction;
- transferability of the results beyond the selected study areas;
- different crime types in different countries.

Prediction bias

- It usually starts from the **data input**: missingness, not representative, too skewed
- If the training data includes **inequalities**, the algorithm can keep propagating those inequalities
- **Location-based algorithms** and individual targeting algorithms are different, but they can both be biased based on historical data
- A **diverse team** is recommended to review the work.

Notes

- **proxy for crime** occurrences -> **potential value** subset depending on analysis purpose; **models tailored** to the characteristic of a crime type
- **social media subsets** - greater impact in prediction models
- statistically significant **social media subsets** (mostly crime-related tweets)
- tweets can be highly correlated with crimes, but the **estimated influence** varies across crime categories
- an increase in social media when **crime is stable** can deviate the prediction
- strong spatial and temporal patterns -> **historical data** may be enough to predict immediate future

New technologies, modern applications – adapting theory?

- Environmental criminology, criminology of place
- Integration of new data: location data availability, social media
- Fans behavior
- Stadia restructuring based on needs – new crimes emerging?
- **More collaboration between fields of study and between researchers and practitioners**

Times are changing. Everywhere. In every field.

Thank you!

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