Predictive Policing in Practice

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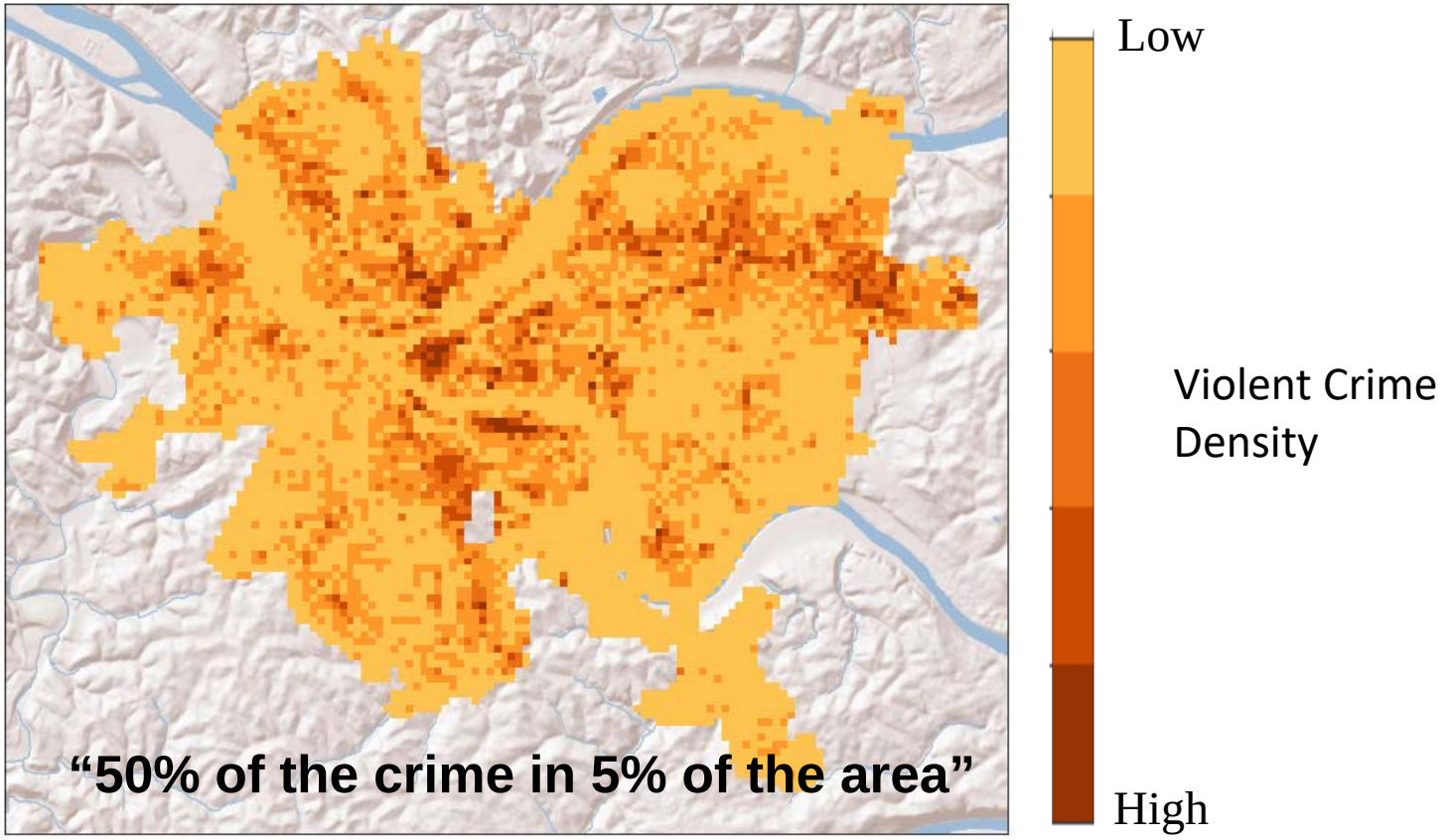
This talk is based on joint work with Wil Gorr & Dylan Fitzpatrick (CMU), supported by the Richard King Mellon Foundation and by Carnegie Mellon University's Metro 21 Initiative.

Motivation

- Police agencies are shifting resources from *reactive policing* to *proactive policing.*
- There is a corresponding emphasis on understanding predictable patterns in which crimes occur.
- Growing evidence that targeted, proactive patrols can reduce crime in patrolled areas (NASEM, 2018).

Crime hot spots



Relatively few small areas, **crime hot spots**, tend to produce most calls for police response and subsequent crime reports (Weisburd, 2015).

Research questions

What are the impacts on crime volume of a small-scale proactive policing program that targets predicted hot spots?

Previous studies were large in scale and resource requirements, and focus additional police effort on chronically crime-ridden areas.

Impacts on crime reduction have been inconsistent:

Hunt et al. (2014): no significant reduction in Shreveport, Louisiana
Mohler et al. (2015): small but significant reduction in Los Angeles.

What is the optimal design of a hot spot program with respect to multiple competing police objectives?

1. Capture high crime volume in targeted hot spots
2. Provide fair and equitable distribution of policing effort

Randomized field trial design

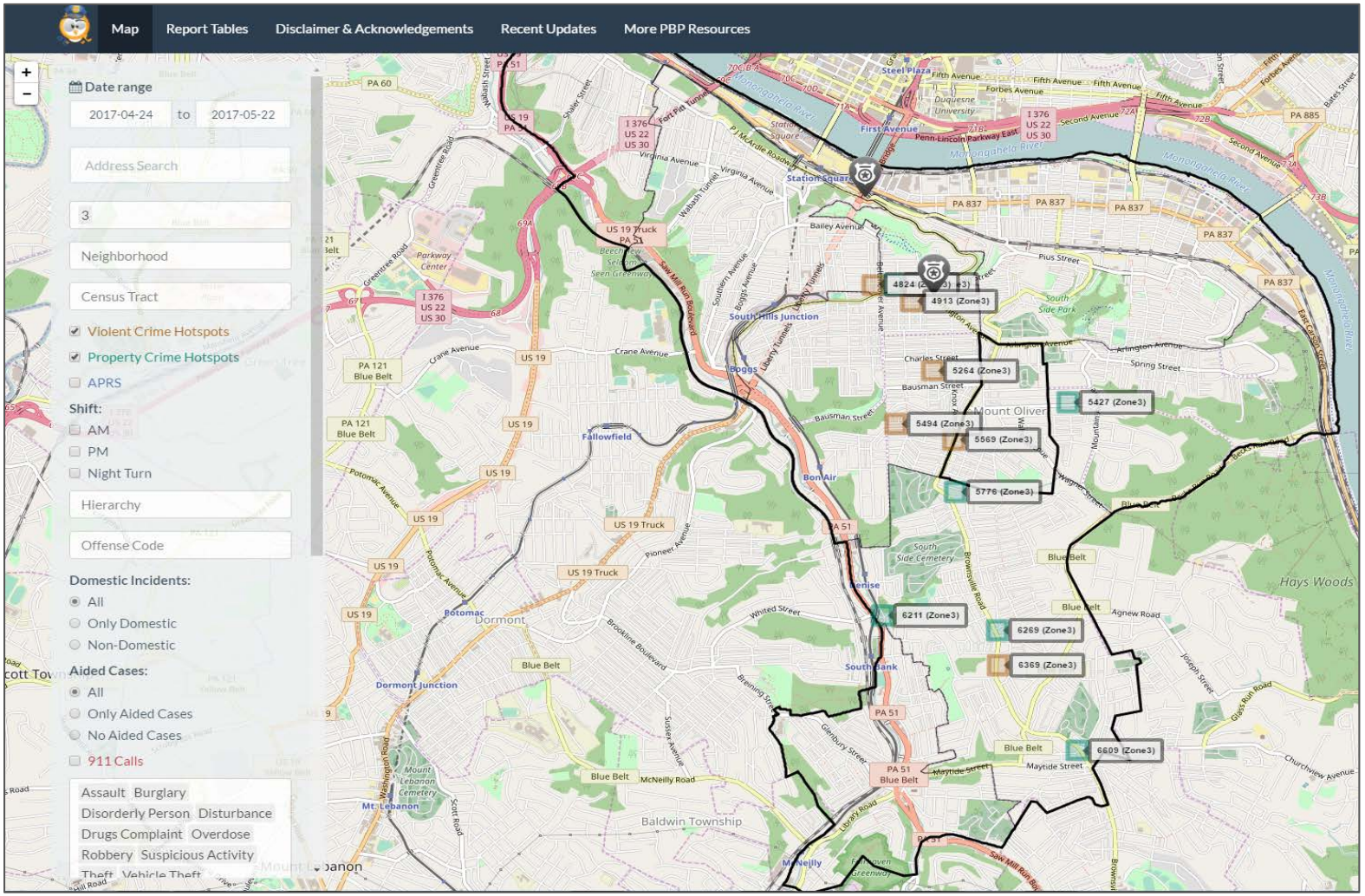
In partnership with the Pittsburgh Bureau of Police, we designed and implemented a crime hot spot program based on 1-week-ahead forecasts of serious violent crime.

Data sources used for prediction include **crime incidents** from PBP's Automated Police Reporting System and **911 emergency calls** from CAD system, coded and geotagged.

16-month longitudinal crossover experiment. We partitioned the city and compared predicted hot spots in treatment and control areas to estimate treatment effect of targeted patrols.

36 grid cells (each 500 ft^2) provided to PBP each week.

Goal: 15 minutes of additional patrol per cell per police shift, using a **community-oriented policing** approach.



Hot spot dashboard developed by a PBP analyst shows weekly hot spots and four weeks of crime data.

Mitigating potential issues

Positive feedback loops can lead to **over-policing** of certain neighborhoods or subpopulations

(Lum and Isaac, 2016)

Mainly an issue for victimless crimes (e.g., drug possession) and/or “zero tolerance” policing.

We focus on predicting **serious violent crimes** that are very likely to be reported.

Also, community-based policing prioritizes problem-solving, not arrests of minor offenders.

Focusing police effort on certain neighborhoods takes away resources from other neighborhoods that might need them.

How to improve **equity**?

We explicitly evaluate prediction methods with respect to equity, and try to balance accuracy vs. equity in choice of methods.

We focus on **temporary** rather than just **chronic** hot-spots.

Chronic vs. temporary hot spots

Chronic Hot Spots:

- Represent areas with the highest volume of crime over medium- and long-term.
- Remain fairly static over time.
- Generally in or near large commercial areas.
- Easy to predict (e.g., using a long-term moving average).
- Are often known to police and already have a relatively large police presence.

Temporary Hot Spots:

- Capture short-term flare-ups from typical baseline crime levels.
- Patrolling these areas provides a more equitable and dynamic distribution of policing effort.
- Many examples: residential areas experiencing a spree of burglaries, escalating gang violence, etc.
- Much harder to predict (and only preventable if correctly predicted)!

Based on a systematic comparison of 10 state-of-the-art machine learning methods in terms of accuracy and equity, we chose a deep learning neural network model, modified to predict differences from baseline crime levels.

Results

Observed differences in Part 1 violent (P1V) crime counts between control areas and treatment areas over 16 months of proactive hot spot patrols (May 1, 2017 - September 2, 2018)

	Part 1 violent crimes		
	% Change	# of Crimes	Est. Costs Avoided*
All Hot Spots	-17.2%	-28	$9,973,135
Chronic Hot Spots	-13.2%	-16	$5,698,934
Temporary Hot Spots	-28.6%	-12	$4,274,201
Cells Adjacent to Hot Spots	0.3%	1	-$356,183

*Costs per P1V crime computed as a weighted average of costs to society from individual component crimes reported in McCollister et al. (2010) and inflated to 2018 dollars.

Result #1: Statistically significant evidence that a small-scale hot spot policing program can lead to measurable reductions in crime that are practically valuable to police departments.

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Result #2: Policing of temporary hot-spots leads to greater equity, and much larger proportional reduction in crime counts, as compared to policing of chronic hot-spots.

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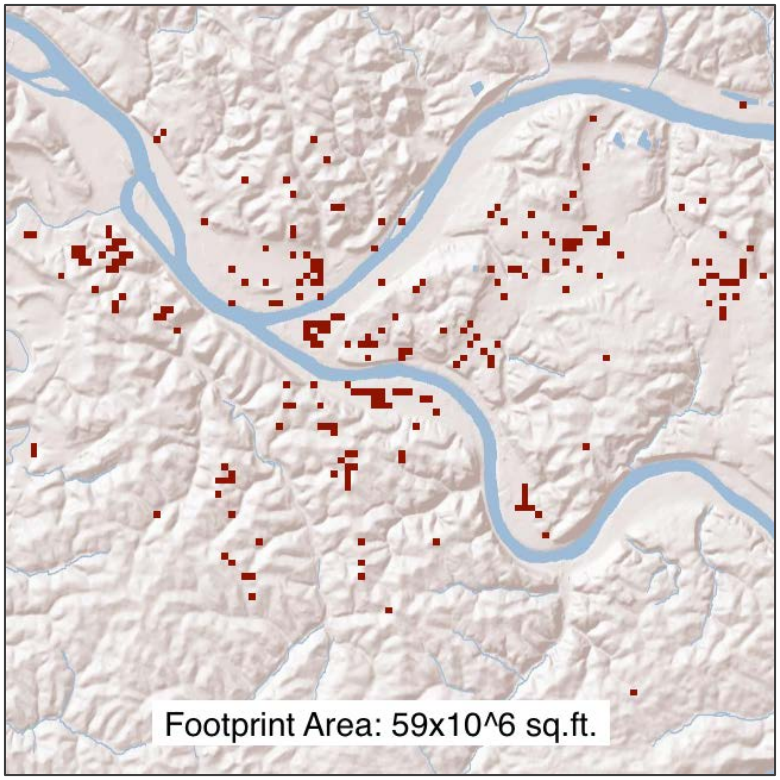
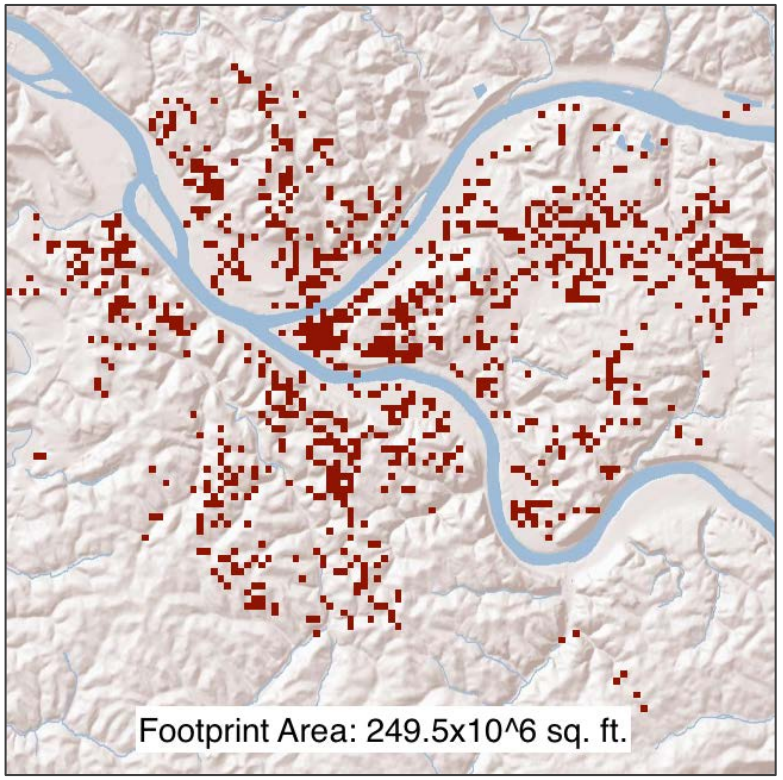
Result #3: No statistically significant evidence of displacement of crime to other areas resulting from patrols to hot spot cells.

Results



Chronic hot spot footprint: 3.4% of city



Temporary hot spot footprint: 14.3% of city

The hot-spot program prevents serious violent crimes, with a largely equitable distribution of police crime prevention resources across the city and with a large return of crime cost avoidance to citizens of Pittsburgh.

References

This talk is primarily based on:

- Dylan J. Fitzpatrick, Wilpen L. Gorr, and Daniel B. Neill. Keeping score: predictive analytics in policing. *Annual Review of Criminology* 2: 7.1-7.19, 2019.
- Dylan J. Fitzpatrick, Wilpen L. Gorr, and Daniel B. Neill. Hot-spot-based predictive policing in Pittsburgh: A controlled field experiment. In preparation.

Other relevant material:

- Anthony A. Braga, Andrew V. Papachristos, and David M. Hureau. The effects of hot spots policing on crime: An updated systematic review and meta-analysis. *Justice Quarterly*, 31(4): 633–663, 2014.
- Wilpen L. Gorr and YongJei Lee. Early warning system for temporary crime hot spots. *Journal of Quantitative Criminology* 31(1): 25-47, 2015.
- George O. Mohler, et al. Randomized controlled field trials of predictive policing. *Journal of the American Statistical Association*, 110:1399–1411, 2015.
- Daniel B. Neill and Wilpen L. Gorr. Detecting and preventing emerging epidemics of crime. *Advances in Disease Surveillance* 4: 13, 2007.

Thanks for listening!

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