

The Spatial Scale of Crime: Consequences for Ecological Studies of Crime



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Ecological studies of crime

- Main question: why do some locations have more crime than others?
 - Chicago School (Shaw and McKay)
- A common feature of the literature:
 - Not a very good conceptualization of spatial mobility by people

Neighborhood studies: need person and household level theory

- EVLN model (exit, voice, loyalty, neglect) (Lowery, Hirschman)
 - Can explain many of the processes observed in neighborhood studies (and some novel predictions)
- Key ideas:
 - Perceptions of individuals – may or may not map on to “reality”
 - Social network ties – develop based on physical distance and social distance
 - Mobility based mostly on physical distance
- Might particularly impact neighborhood change
 - Hipp, John R. and Xiaoshuang Iris Luo. 2022. "Improving or Declining: What Are the Consequences for Changes in Local Crime Rates?". *Criminology* 60(3):480-507

Ingredients for a crime (Routine activity theory)

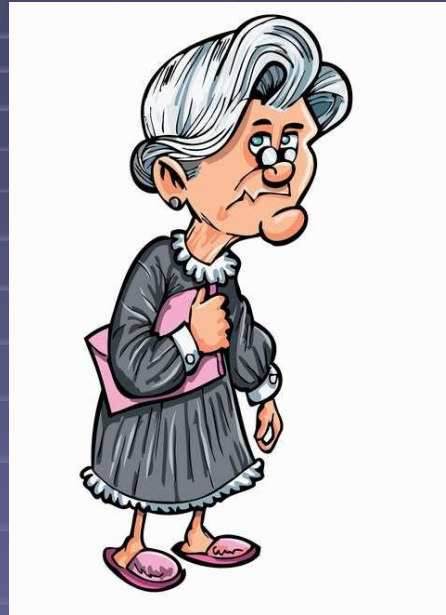


Motivated offender

Ingredients for a crime (Routine activity theory)



Motivated offender



Suitable target

Ingredients for a crime (Routine activity theory)



Motivated offender

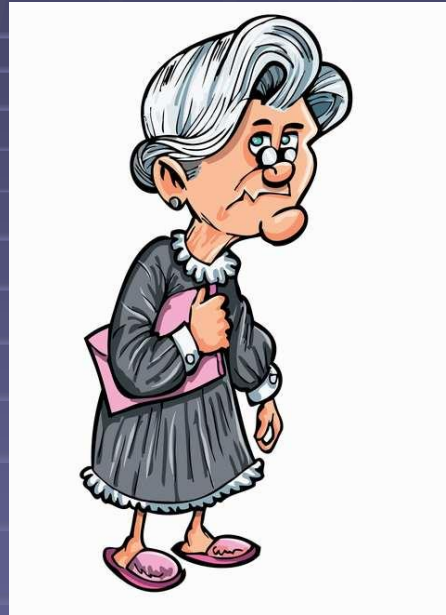


Suitable target



Absence of capable guardians

Ingredients for a crime (Routine activity theory)



Motivated offender

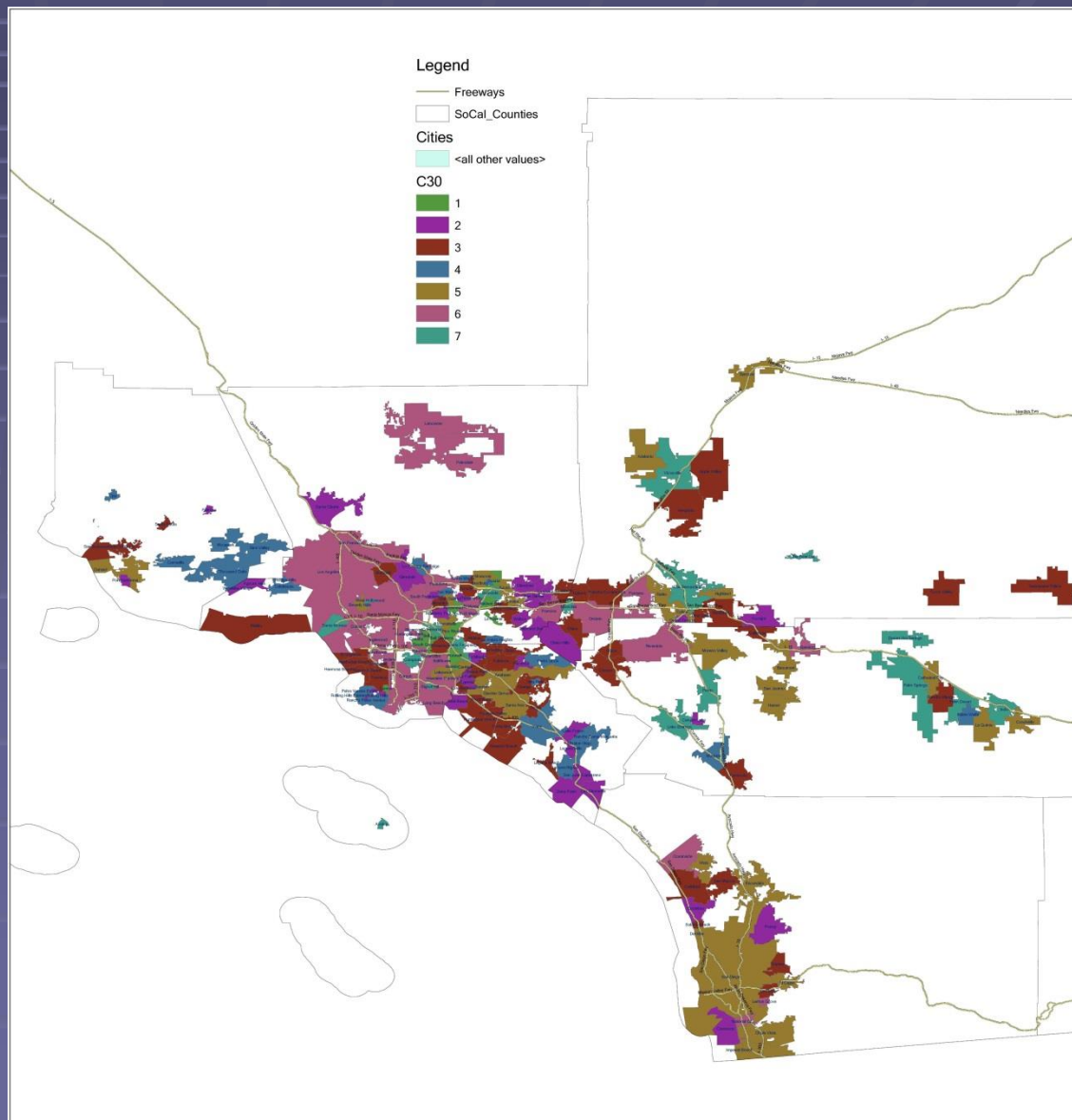
Suitable target

Absence of capable guardians

And, *situation*. Spatial and temporal

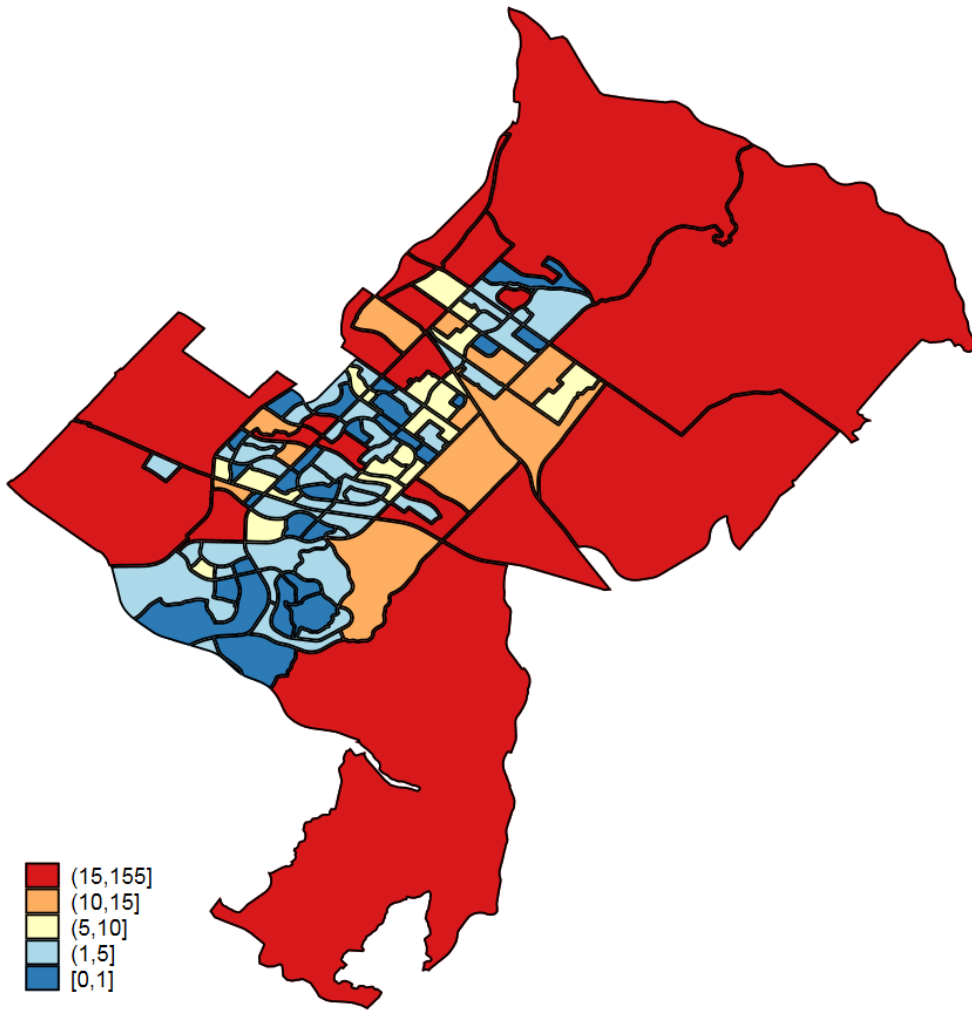
Macro units

- Early work (1980s): comparing city- and county-level crime data.
- Not worried about spatial patterns.
- Proper unit of analysis?



Meso units

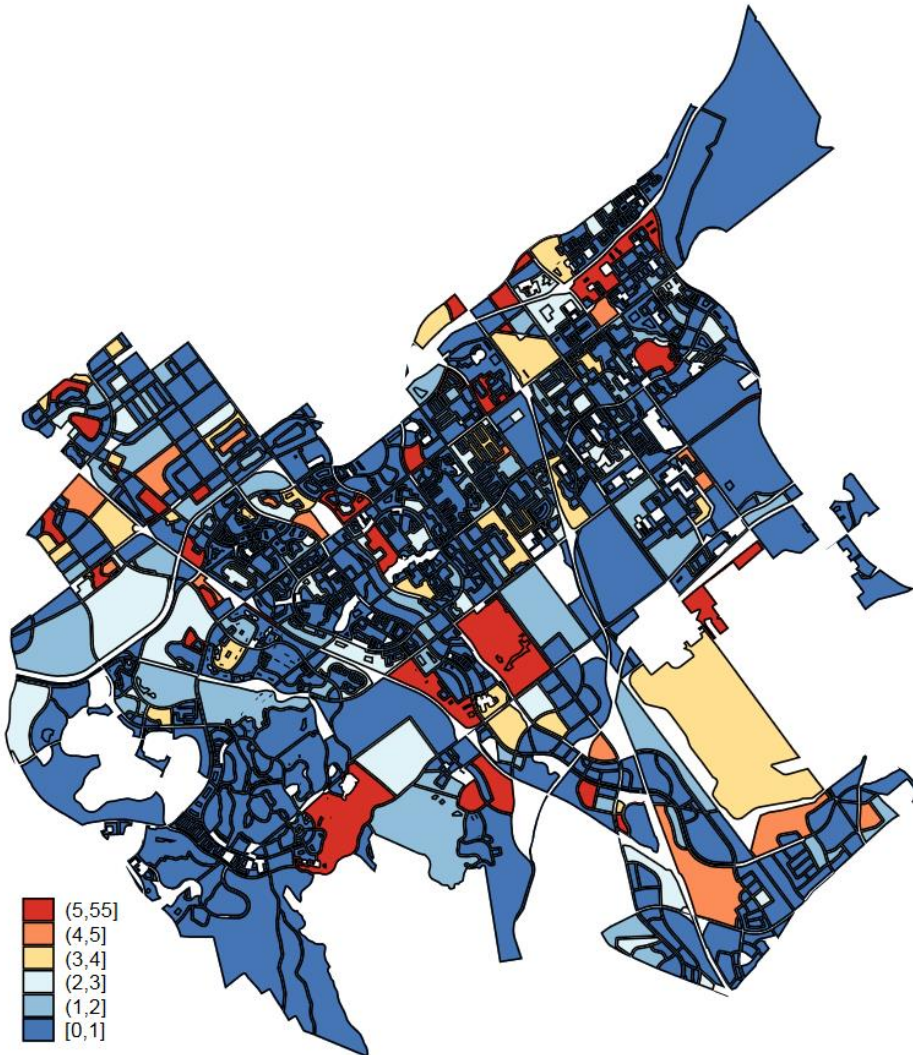
Burglaries in Irvine block groups



- Neighborhood-level data (late 1980s, 1990s, 2000s)
- (also Quetelet)

Micro units

Burglaries in Irvine blocks



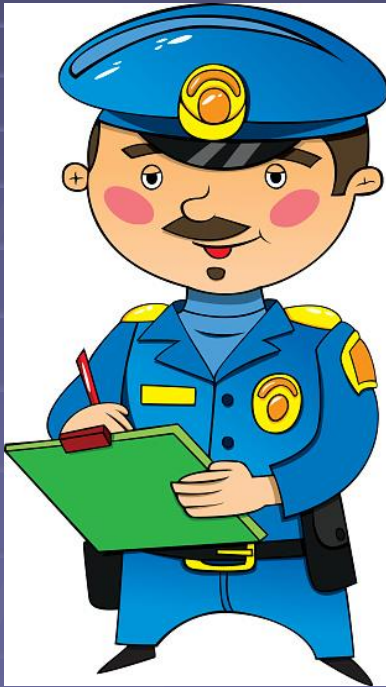
- Now: micro units: blocks, segments
- Next?: parcels (crime concentration)

But two big issues:

- 1) measurement error as police enter the location data (spatial imprecision)

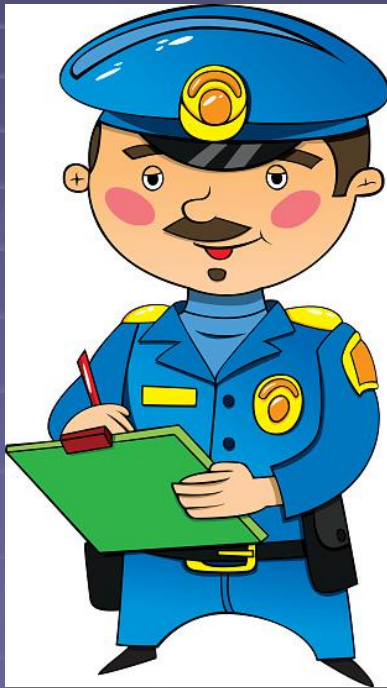
But two big issues:

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- 1) measurement error as police enter the location data (spatial imprecision)



Use a GPS unit?

But two big issues:

- 2- Offenders, targets, and guardians move about

Two broad theories



1) Crime pattern theory: psychology of where people go; routine activity theory

Two broad theories

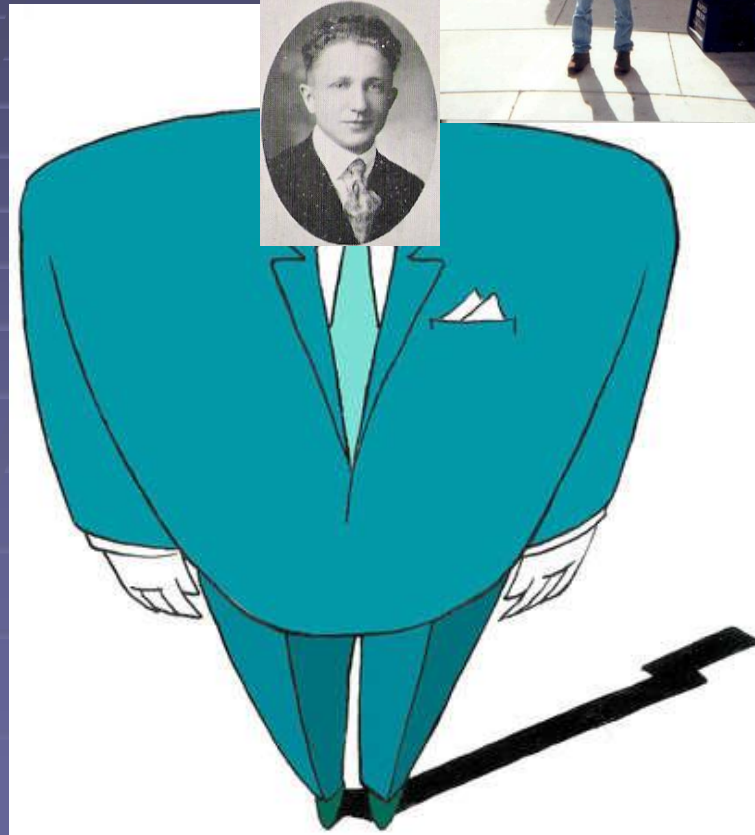


1) Crime pattern theory: psychology of where people go; routine activity theory



2) General theory of spatial crime patterns.

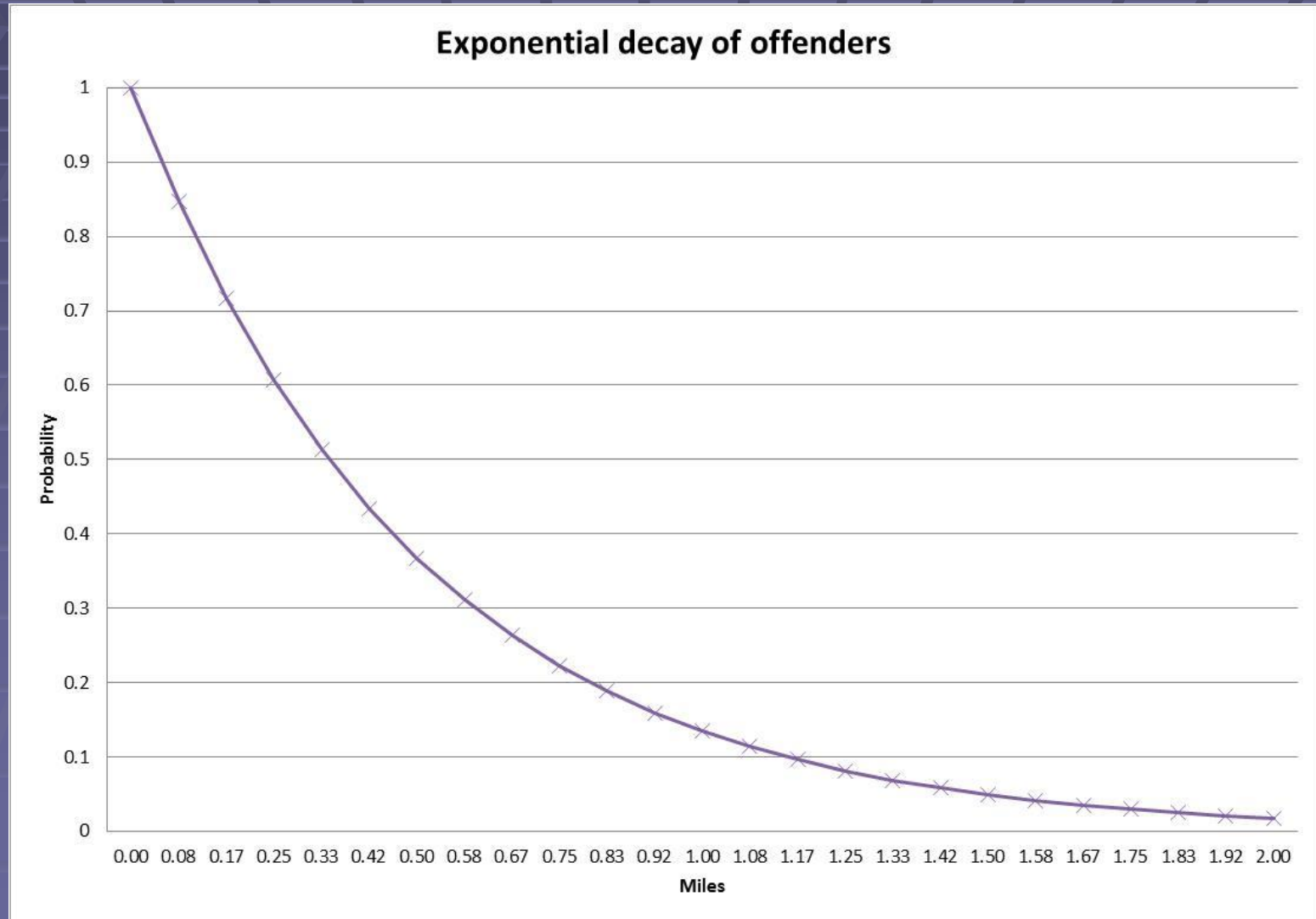




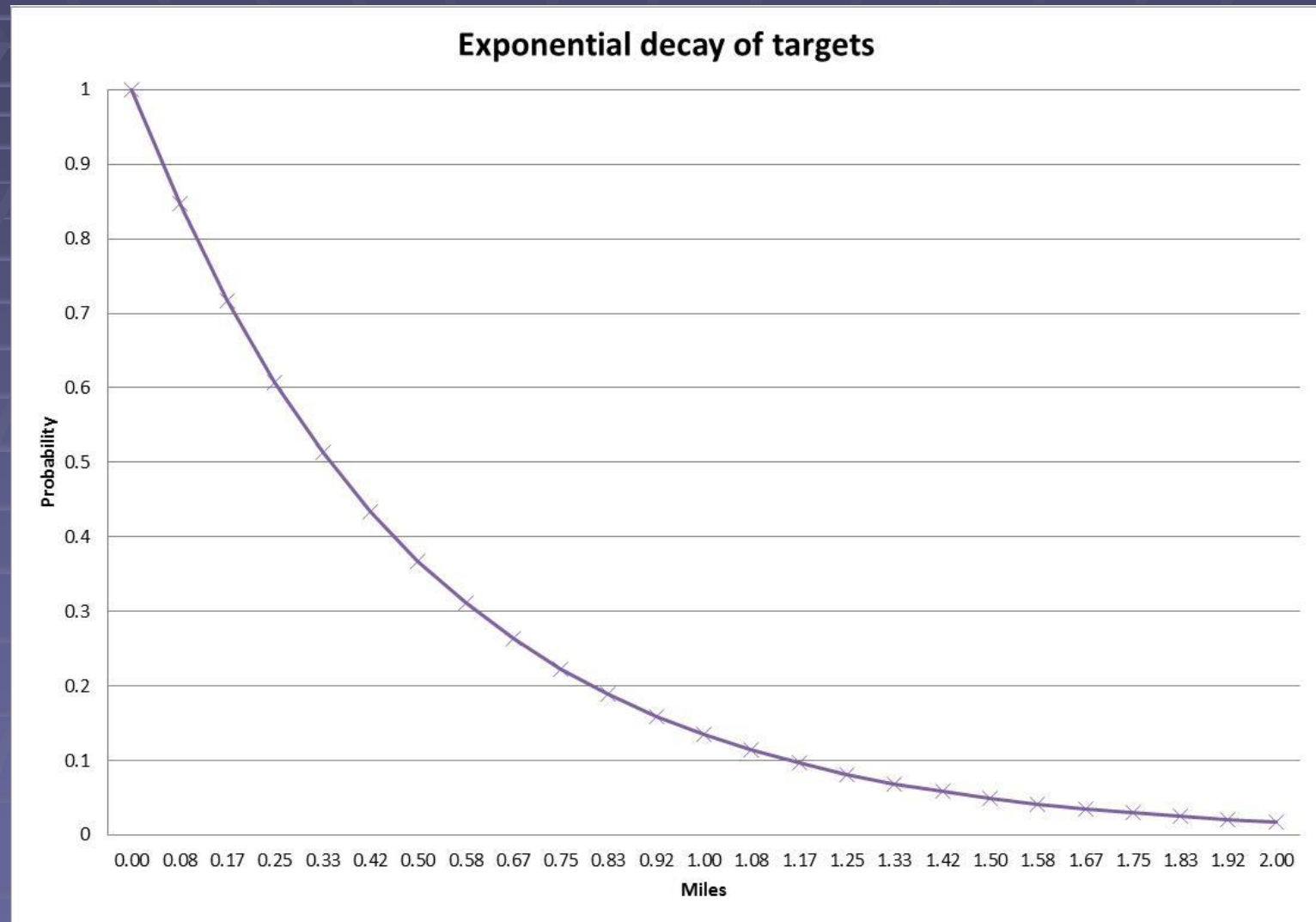
General theory of spatial crime patterns: potentialities

- Principle of least effort (distance decay) (Zipf)
 - Who are offenders, targets, guardians?
 - Not discrete categories.
 - Do not necessarily sum to 100%
 - Where do they live?
 - Try to assess this
 - Where do they travel?
-
- Hipp, John R. 2016. "General theory of spatial crime patterns." *Criminology* 54:653-679.

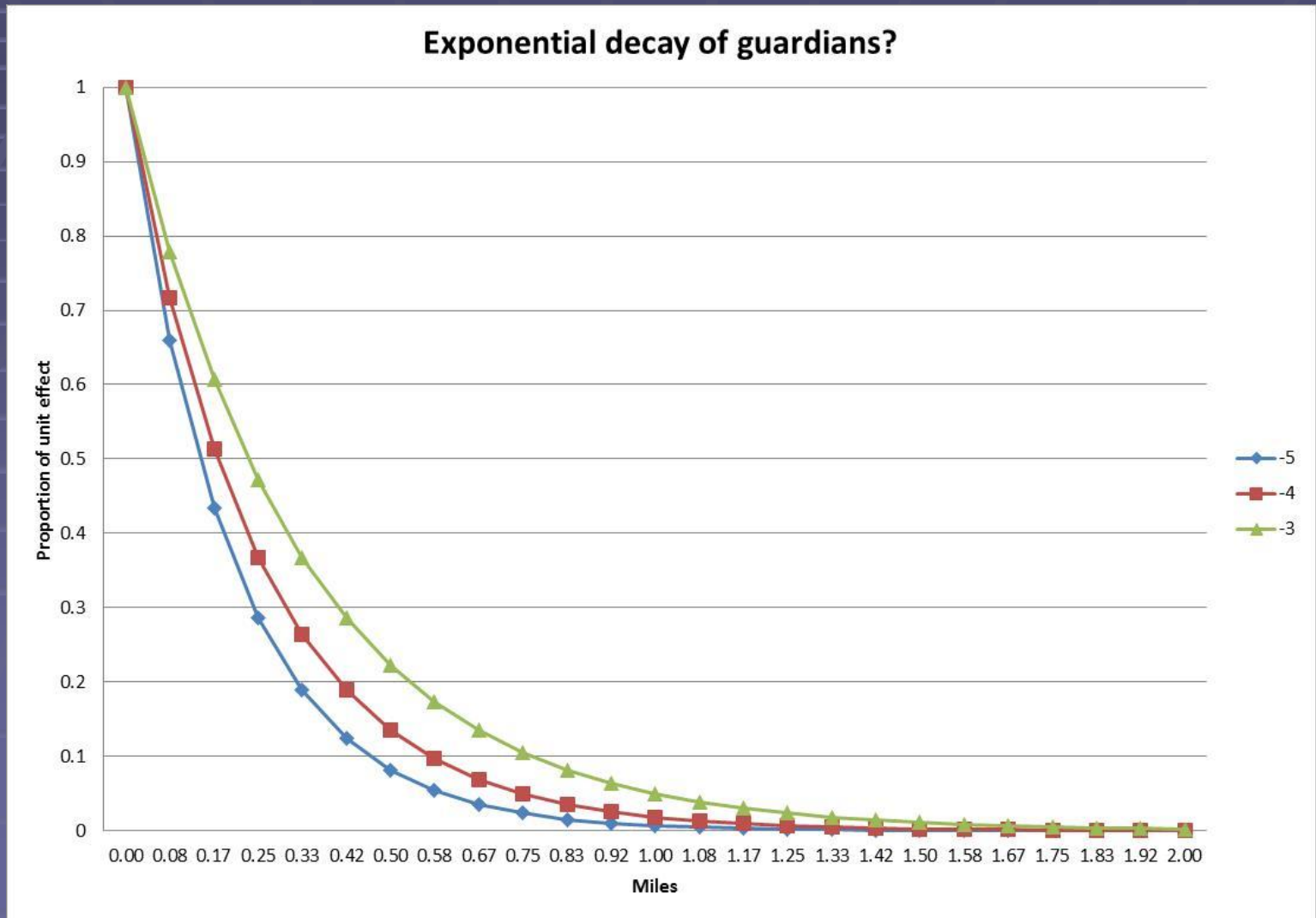
Spatial pattern of offenders



Spatial pattern of targets



Spatial pattern of guardians?



Proof of concept for general theory of spatial crime patterns

- Spatial *and* temporal.
- If crime requires the confluence of offenders, targets and guardians in space and time:
 - Try to predict:
 - the locations where offenders, guardians, and targets live in the spatial landscape
 - where offenders, guardians and targets are likely to go at various times
 - This generates a *crime potentiality* of a location at a time point

Figure 2. Effect of targets and offenders on robbery rates in Santa Ana (all times of day)

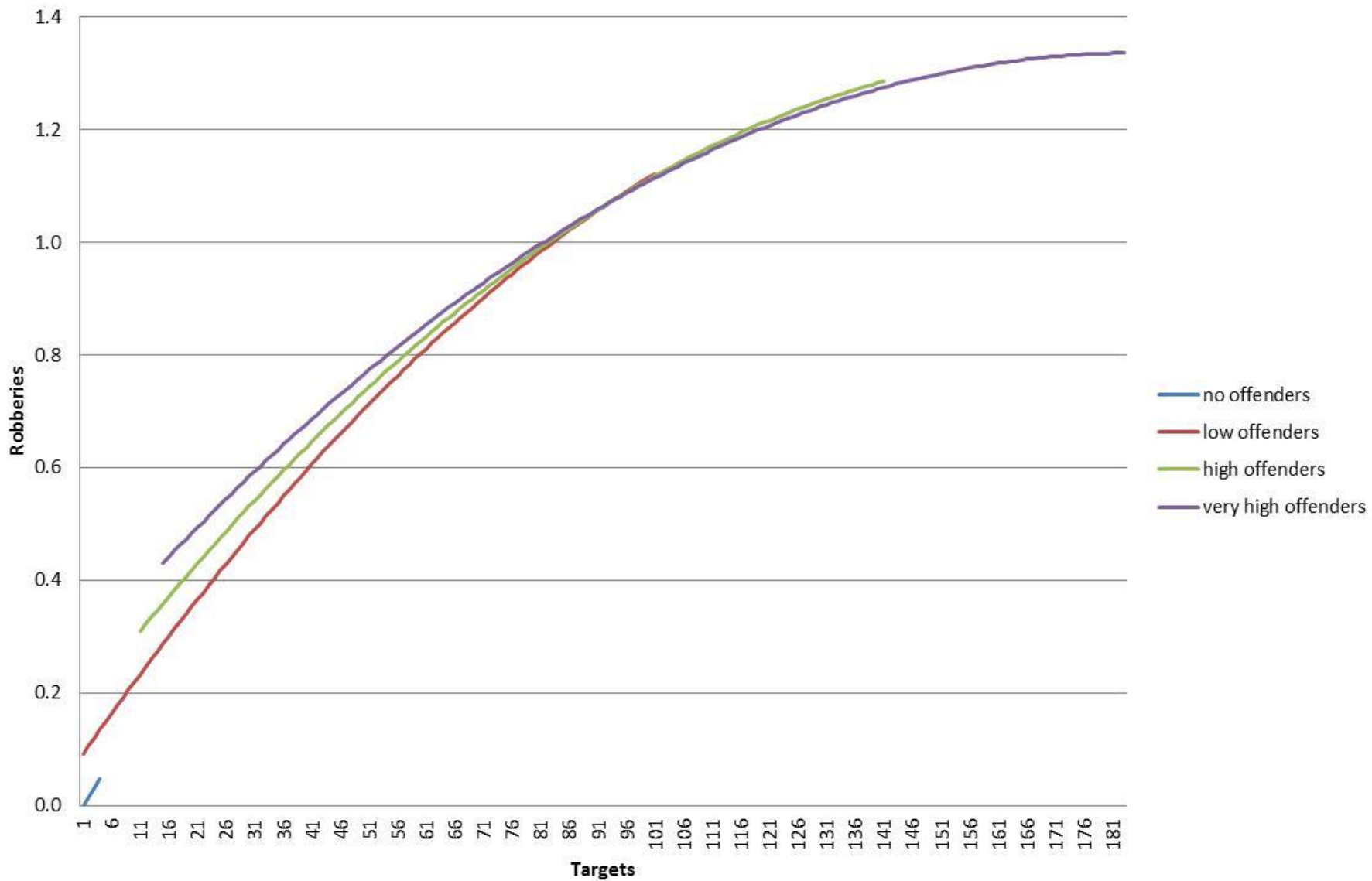


Figure 3a. Model prediction of robberies based on potential presence of offenders and targets from 1-2am

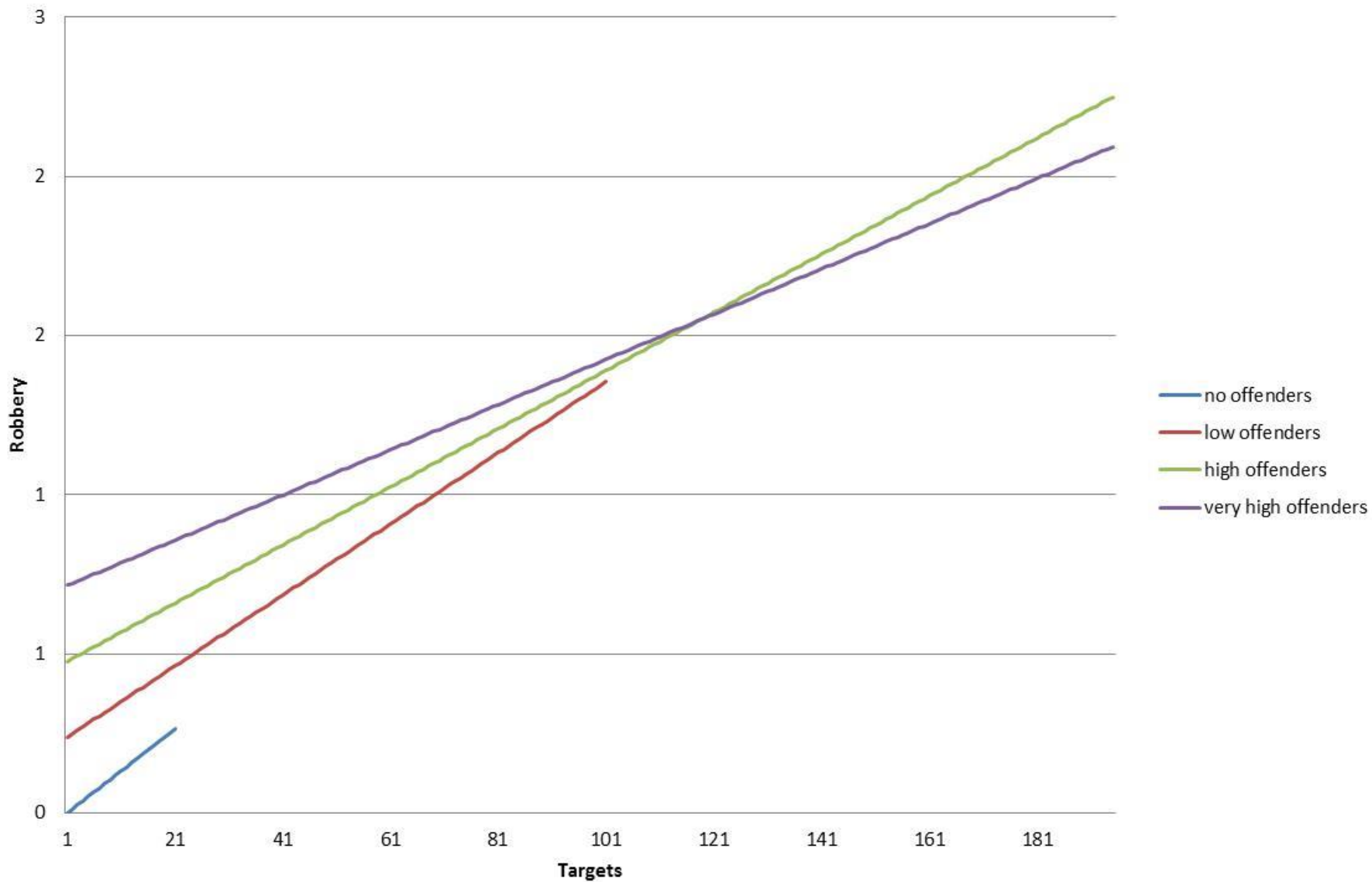
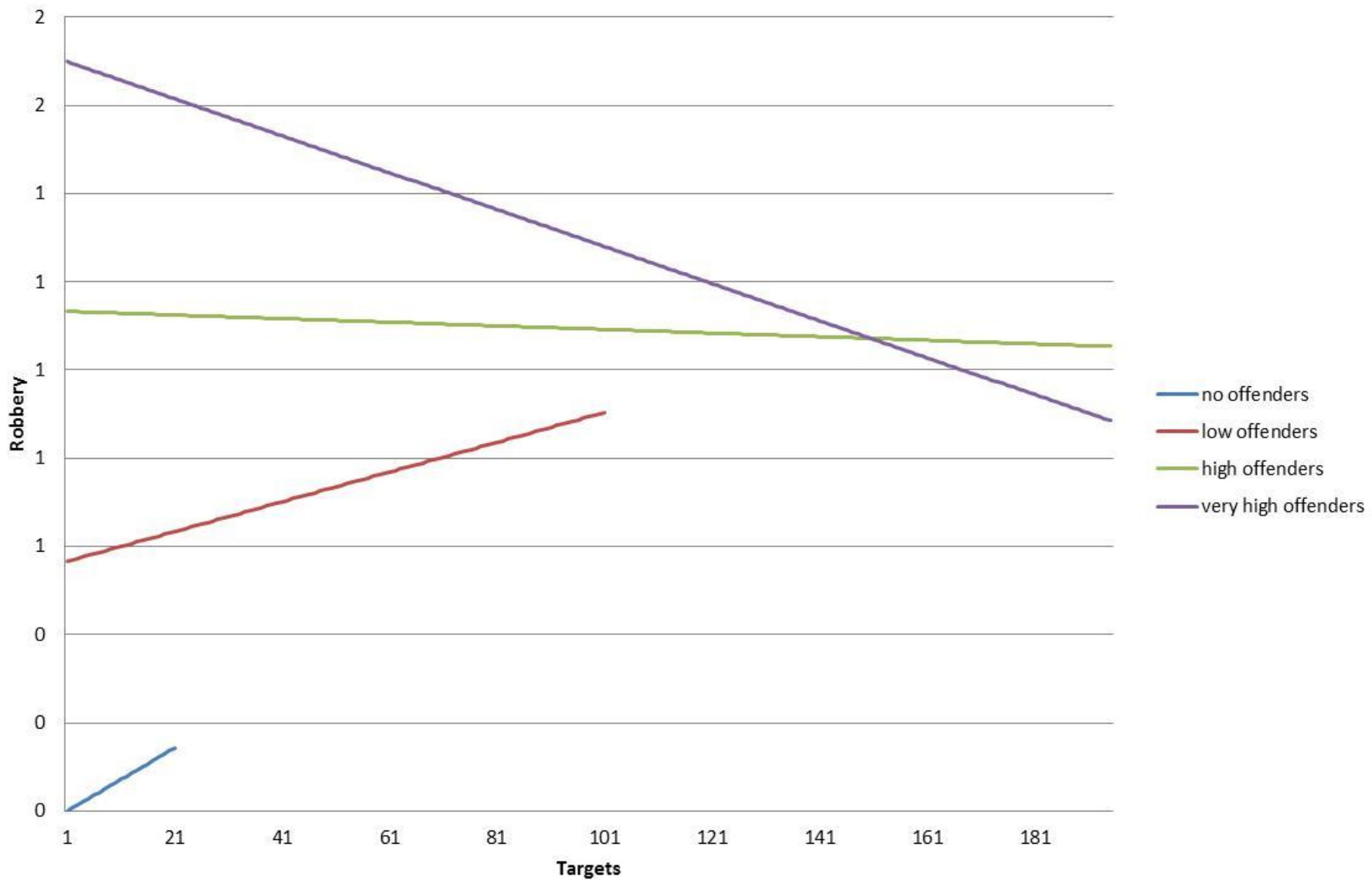


Figure 3b. Model prediction of robberies based on potential presence of offenders and targets from 10-11am



If spatial movement, then: Proper unit of analysis?

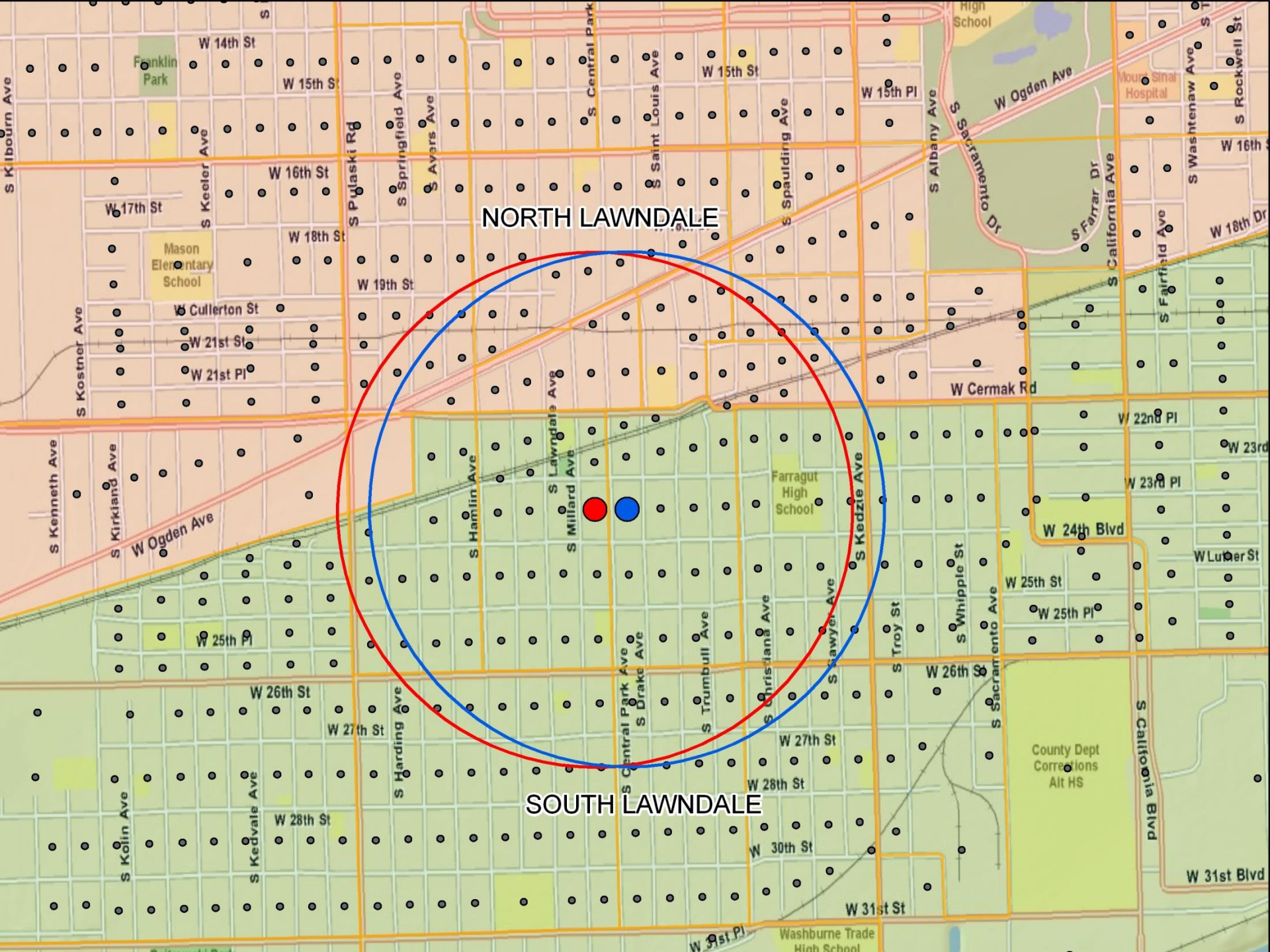
- Ralph Taylor explored this in his book.
- My answer: **None**
- Egohoods?
 - Hipp, John R. and Adam Boessen. 2013. "Egohoods as waves washing across the city: A new measure of "neighborhoods"." *Criminology* 51:287-327.

Egohoods: Insights from other research traditions

- We live at the center of our “own” neighborhood (an *ego*hood)
- Presence of social ties
 - Tie probability decays over distance
- Daily activities literature
 - Where do you spend your time?
 - Our daily activities often are centered on our block
- Mental mapping literature
 - Where do you place *yourself* in your neighborhood?
 - We perceive ourselves at the center of the neighborhood (Hunter, 1974)
- Travel to crime literature
 - Distance decay

Egohoods: Center of your world

- Public health literature: buffers around persons
- “Neighborhoods” around plants:
 - Silander, John A. Jr., and Stephen W. Pacala. 1985. "Neighborhood Predictors of Plant Performance." *Oecologia* 66(2):256-263.
- Reardon, Lee, Firebaugh et al in segregation literature
- Block is the center of the egohood



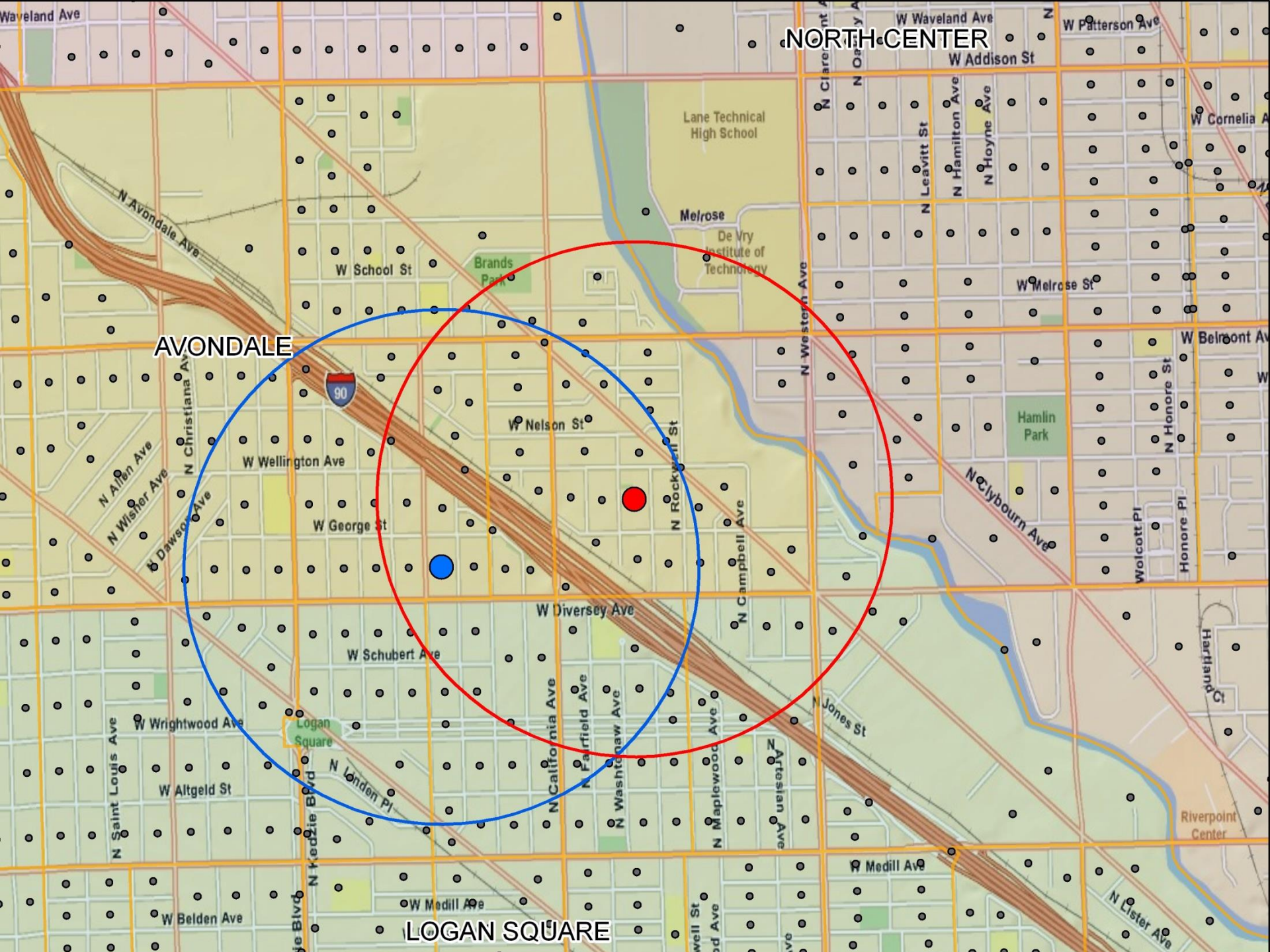
NORTH LAWDALE

SOUTH LAWDALE



Egohoods

- If everyone is in the center of their own egohood, then we're also in *other persons'* egohoods
- So, not discrete units
- Physical boundaries might matter also
 - Rivers, freeways, etc
- Social boundaries might matter also
 - School districts
 - Shopping areas
 - Churches



NORTH CENTER

AVONDALE

LOGAN SQUARE



Lane Technical High School

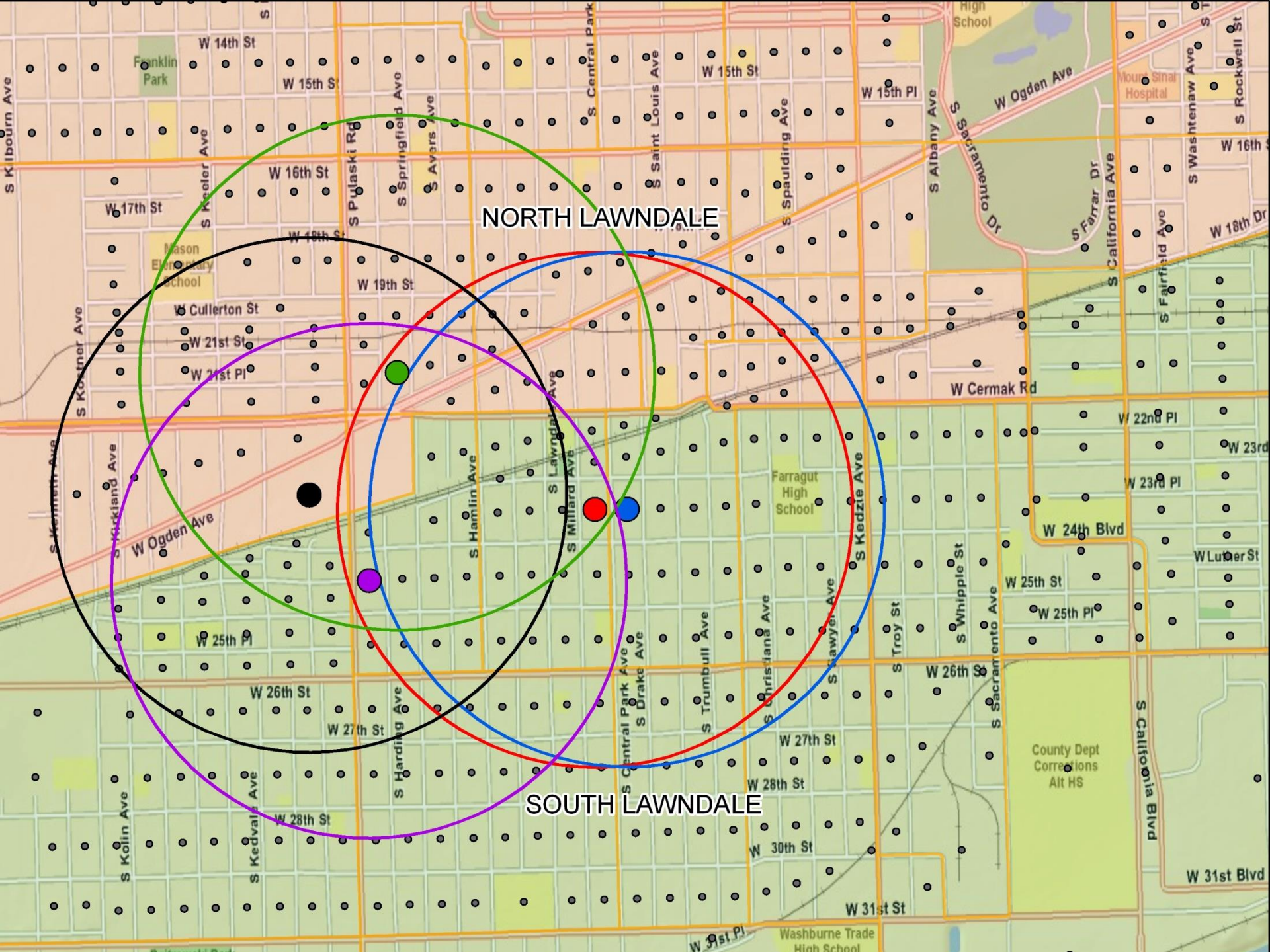
Melrose
De Vry Institute of Technology

Hamlin Park

Riverpoint Center

Egohoods

- Neighborhoods as waves washing across the surface of the city



Average population size of egohoods

Radius	Population
0.25 mile	1,100
0.5 mile	4,131
0.75 mile	8,809
1.5 mile	30,866
2.0 mile	50,931
3.0 mile	100,886

Explicit spatial measures for crime

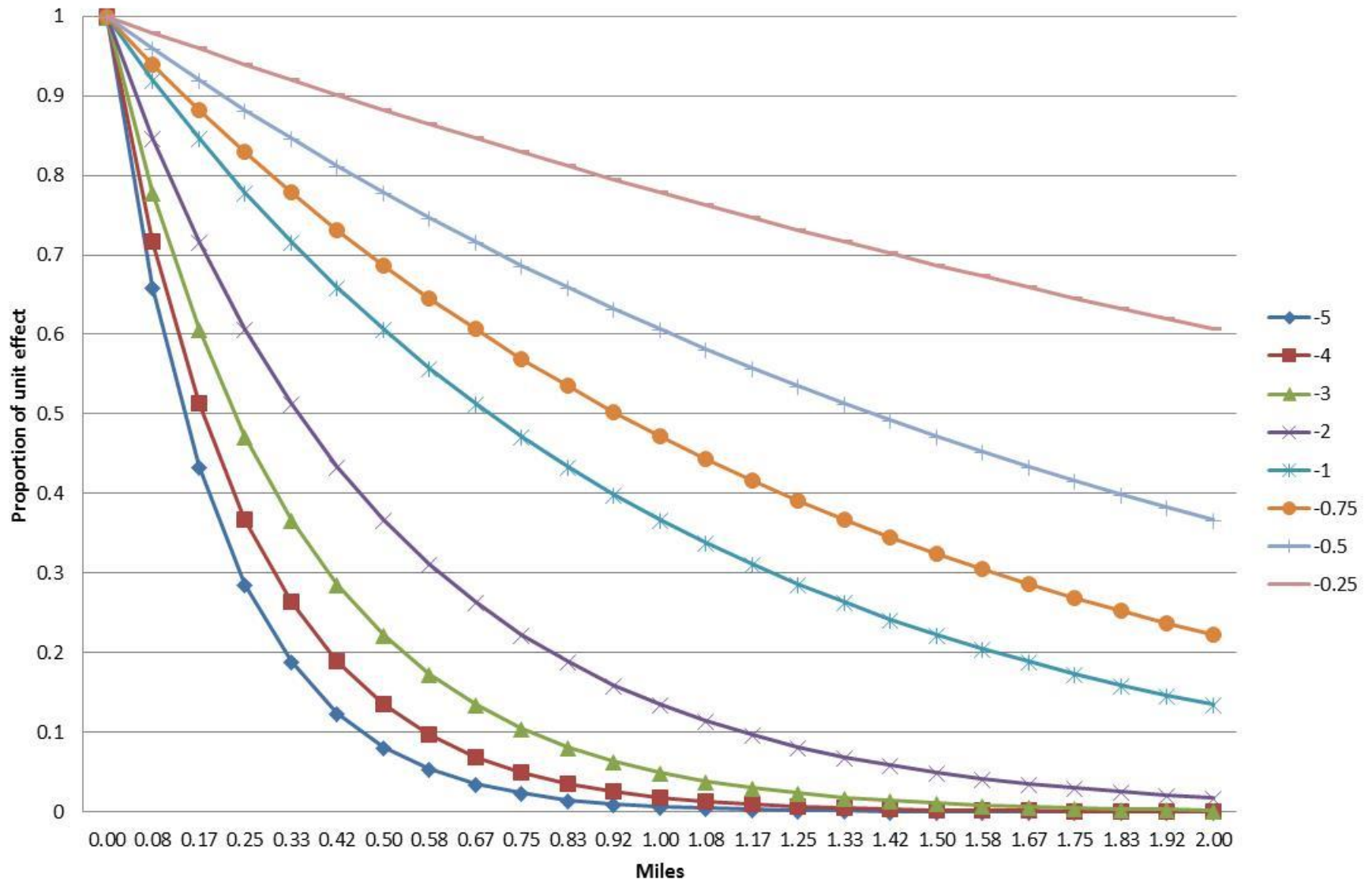
Explicitly considering spatial patterns

- A challenge: what do various demographic measures proxy for?
 - Offenders, targets, or guardians?
 - Or a mix?
 - Hipp and Bates, Oxford Handbook of Environmental Criminology, 2017
- Common strategy of ecological studies:
 - Measure in geographic unit
 - Measure as a spatial decay
- But, not theoretically motivated

Decay functions

- Construct them based on a distance decay with an exponential function
 - Targets (businesses)
 - Very sharp decay
 - Targets (people)
 - Broader decay
 - Offenders (types of people)
 - Broader decay
 - Guardians (e.g., homeowners)
 - Sharp decay

Figure 1. Exponential decay functions with different beta values



Decay functions: multiple processes

- Parks
 - Sharp decay- crime opportunities (positive)
 - Broad decay- create cohesion, increase potential guardianship (negative)
- Nonconsumer businesses
 - Sharp decay- crime opportunities (positive)
 - Broad decay- provide jobs, so reduce offenders (negative)

Spatial scale of crime

What do we learn in standard ecological studies of crime?

- Simulation project (use OC as setting)
- Targets: specific location (no mobility)
- No guardians
- Two measures of offenders
 - Disproportionate likelihood
 - Everybody
- Two assumptions of offender behavior in target rich environments
 - Unlimited offending
 - Satiation: zero sum offending
- Hipp, John R. 2020. "Simulating Spatial Crime Patterns: What do we Learn in Standard Ecological Studies of Crime?" *Journal of Criminal Justice* 70:1-10.

What do we learn in standard ecological studies of crime?

- Simulation results:
 - At block level, targets explain most of variation
 - But, adding nearby offenders (and interaction with targets) helps (but not if zero-sum)
 - At neighborhood level, targets and offenders matter
 - But better to measure offenders as spatial decay
 - At city level, offenders (as spatial decay) explain most of variation
- Lesson: *explained variation is over-emphasized*

Do factors *cause* crime, or *shift* its location?

- Simple example: bars *cause* more crime
 - Street block study finds positive relationship
 - Neighborhood study also finds positive relationship (as long as proper controls in model)
 - City study also finds positive relationship
- Simple example: bars *shift* crime location
 - Street block study finds positive relationship
 - Neighborhood study finds a weak or no relationship
 - City study would find no relationship

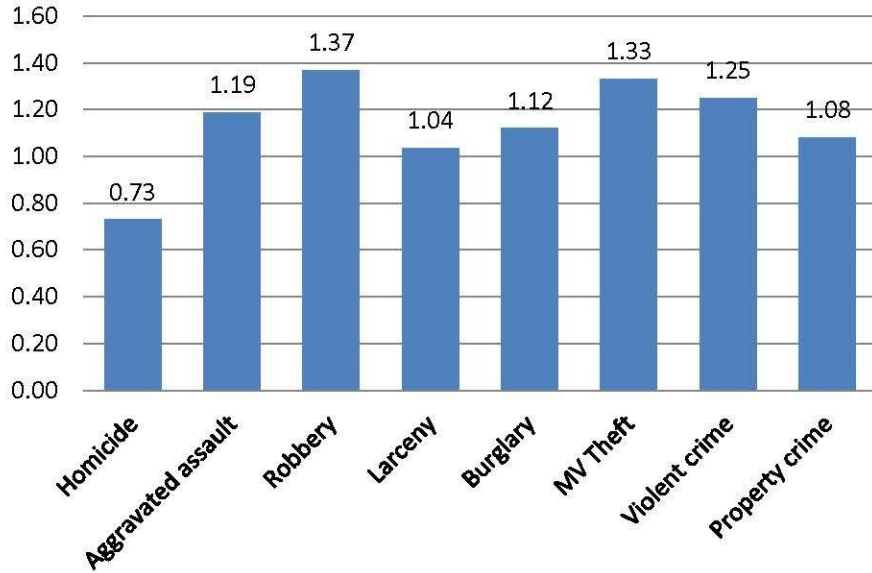
Scaling effects of population

- Population used to normalize crime: create *rates*
- In micro-geographic units, almost no relationship between residential population and crime
- In neighborhoods, there is a somewhat more reasonable relationship (although there are exception neighborhoods)
- In larger macro units, a reasonable relationship
- What are the implications of this pattern?

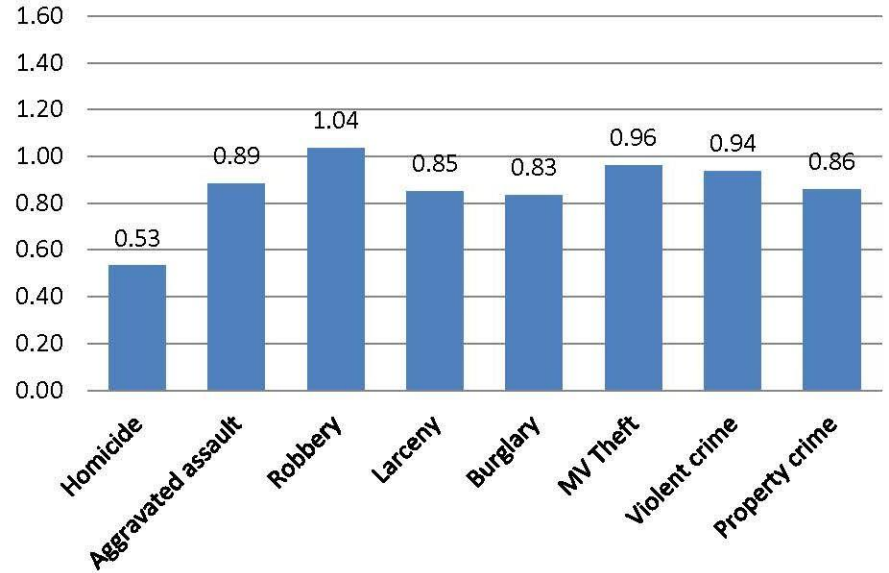
Scaling effects of population

- Literature: how measures scale with metropolitan population (e.g., Bettencourt; Geoffrey West)
- Strategy: compute the population (log transformed) and the measure of interest (log transformed), and regress the measure on population
- If a one to one relationship, will have a coefficient of 1
- Superliner relationship: logged pop coefficient greater than 1
 - As population increases, the other measure increases even more rapidly
- Sublinear relationship: logged pop coefficient less than 1
 - As population increases, the other measure increases more slowly
- Commonly observed that crime tends to scale superlinearly

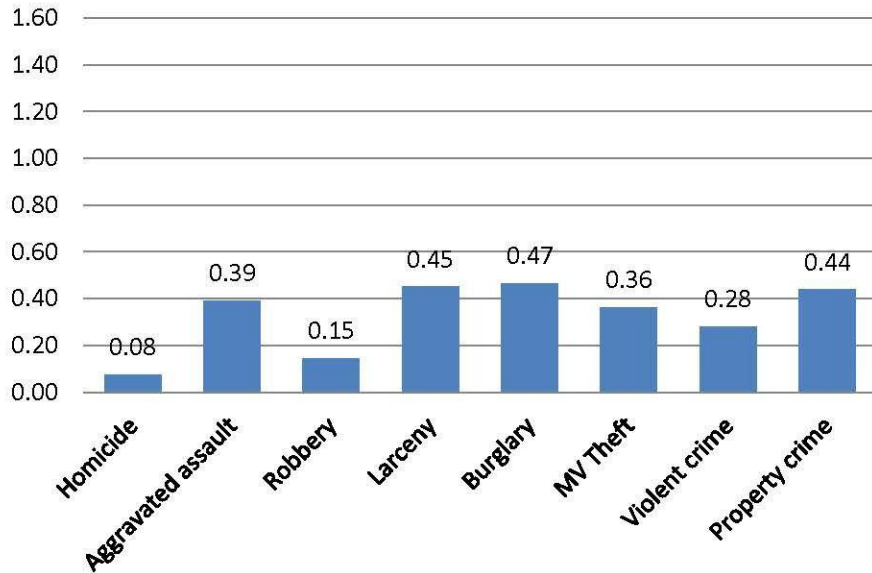
A. Logged population and logged crime counts



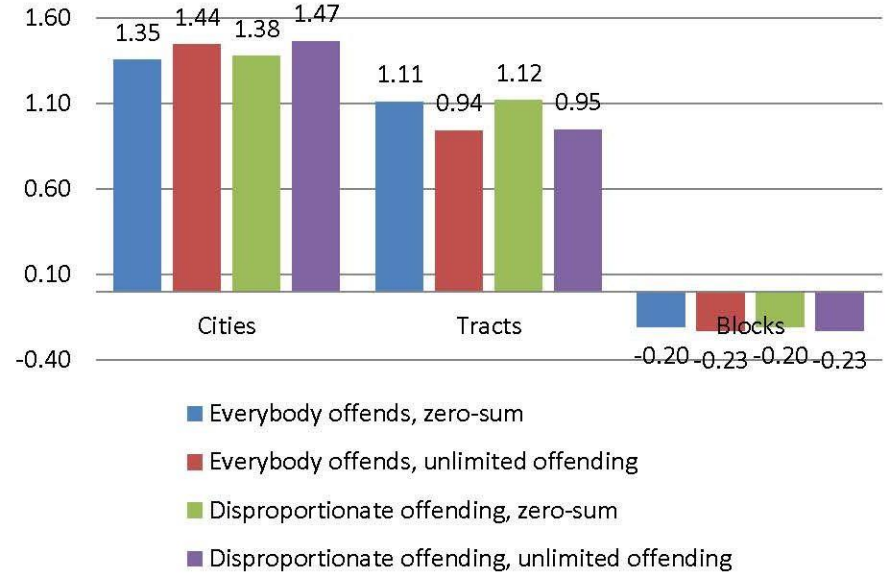
B. Logged employees and logged crime counts



C. Logged population and logged crime counts in tracts



D. Logged population and logged simulated crime



- Everybody offends, zero-sum
- Everybody offends, unlimited offending
- Disproportionate offending, zero-sum
- Disproportionate offending, unlimited offending

Conclusions

- Need to consider what our measures are proxying for
 - Offenders? Targets? Guardians?
 - To what extent does this impact the expected spatial scale?
- How to determine the optimal scale? Simply based on best model fit?
 - Does this improve model fit? Must it?
- Does this explain total crime in macro unit? Or change over time?



Thank you!



Further readings:

- Hipp, John R. 2023. *The Spatial Scale of Crime: How Physical and Social Distance Drive the Spatial Location of Crime*. New York: Routledge.
- Hipp, John R. 2016. "General Theory of Spatial Crime Patterns." *Criminology* 54(4):653-79.
- Hipp, John R. 2020. "Simulating Spatial Crime Patterns: What Do We Learn in Standard Ecological Studies of Crime?". *Journal of Criminal Justice* 70:1-10.
- Hipp, John R. and Adam Boessen. 2013. "Egohoods as Waves Washing across the City: A New Measure of "Neighborhoods"." *Criminology* 51(2):287-327.
- Hipp, John R. and Seth A. Williams. 2020. "Advances in Spatial Criminology: The Spatial Scale of Crime." *Annual Review of Criminology* 3:75-95.
- Hipp, John R. and Young-an Kim. 2017. "Measuring Crime Concentration across Cities of Varying Sizes: Complications Based on the Spatial and Temporal Scale Employed." *Journal of Quantitative Criminology* 33(3):595-632.
- Hipp, John R. and Seth A. Williams. 2021. "Accounting for Meso- or Micro-Level Effects When Estimating Models Using City-Level Crime Data: Introducing a Novel Imputation Technique." *Journal of Quantitative Criminology* 37:915-51. doi: <https://doi.org/10.1007/s10940-020-09473-7>.
- Hipp, John R. and Xiaoshuang Iris Luo. 2022. "Improving or Declining: What Are the Consequences for Changes in Local Crime Rates?". *Criminology* 60(3):480-507.
- Hipp, John R. 2016. "Collective Efficacy: How Is It Conceptualized, How Is It Measured, and Does It Really Matter for Understanding Perceived Neighborhood Crime and Disorder?". *Journal of Criminal Justice* 46(1):32-44.
- Hipp, John R. and Rebecca Wickes. 2018. "Problems, Perceptions and Actions: An Interdependent Process for Generating Informal Social Control ". *Social Science Research* 73(1):107-25.