

What to do about geographic interventions?

Greg Ridgeway
Department of Criminology
Department of Statistics

- Emergency winter homeless shelters in Vancouver
- Transit stations in Los Angeles
- Civil gang injunctions in Los Angeles
- Opiate treatment centers in Philadelphia

- Emergency winter homeless shelters in Vancouver
- Transit stations in Los Angeles
- Civil gang injunctions in Los Angeles
- Opiate treatment centers in Philadelphia

S.-L. Faraji, G. Ridgeway, and Y. Wu (2018). “Effect of Emergency Winter Homeless Shelters on Property Crime,” *Journal of Experimental Criminology* 14(2):129-140.

Since 2009 Vancouver Operates Emergency Winter Shelters

- Prompted by Dawn Bergman who died when her shopping cart caught fire
- 6-9 shelters housing 30-200 people operating from December to April

Progress	Documents	Details	Background
2017-2018 temporary shelters to open 301 beds			
October 18, 2017 - This fall 301 beds will become available at 10 temporary shelter locations in Vancouver, thanks to funding from the BC Government and the City of Vancouver.			
Shelter address	Beds	Opening hours	Operator
1648 E 1st Ave	40, for men and women	24 hours, 7 days per week, Open November 8	RainCity Housing and Support Society
1401 Hornby St	40, for men and women	24 hours, 7 days per week, Open November 1	RainCity Housing and Support Society
1060 Howe St	30, for men and women	6:00pm - 10:00am, 7 days per week	Community Builders

Neighbors Fear Decline in Property Value, Business Disruption, and Crime

- 38% of Vancouver's homeless suffer from mental illness
- 53% suffer from addiction

South Vancouver residents protest housing units for homeless



Vancouver Mayor Gregor Robertson is fielding complaints about a proposed housing site for homeless people in the city's Marpole neighbourhood.

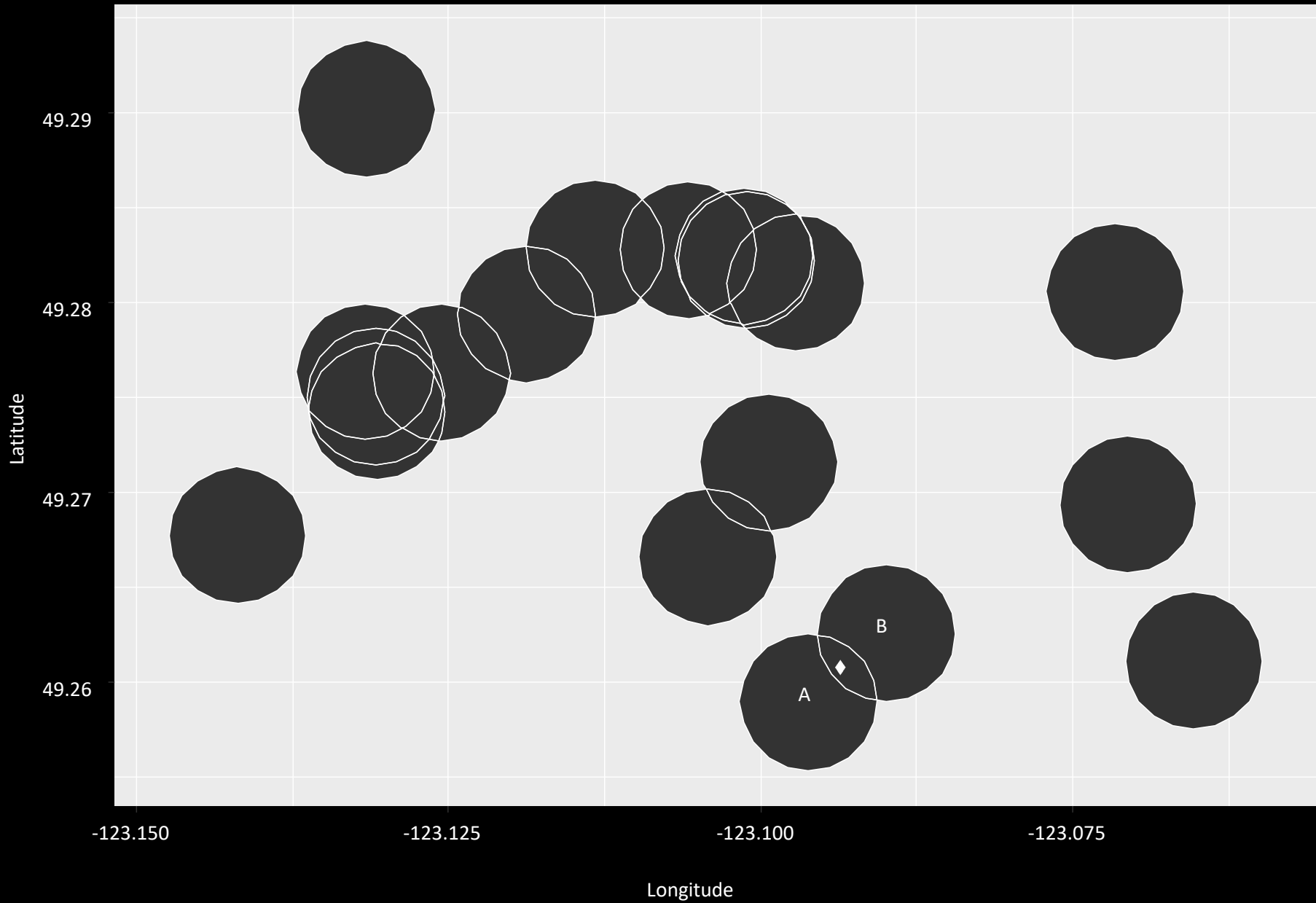
RAFAL GERSZAK/THE GLOBE AND MAIL

FRANCES BULA >
VANCOUVER
SPECIAL TO THE GLOBE AND MAIL
PUBLISHED OCTOBER 26, 2017

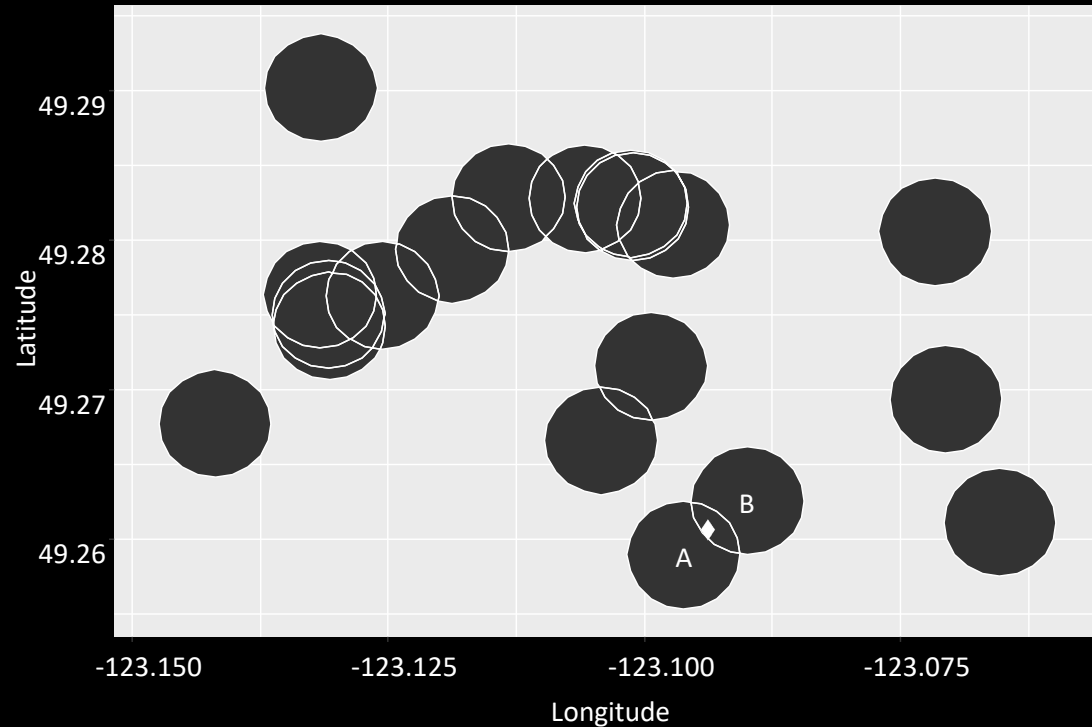
The first tussle in what is expected to be a wave of controversy over housing the homeless erupted Thursday as south Vancouver residents turned out to argue with Vancouver Mayor Gregor Robertson about a proposed site in their neighbourhood.

Shelters Frequently Close Down and Relocate

Shelter Address	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
134 East Cordova Street		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
51B W Cordova Street				✓	✓	✓	✓	✓	✓	✓	✓
320 Hastings Street				✓	✓	✓	✓	✓	✓	✓	✓
201 Central Street				✓	✓	✓	✓	✓	✓	✓	✓
1442 Howe Street				✓		✓	✓				
1435 Granville Street				✓	✓						
1642 West 4th Avenue					✓	✓					
747 Cardero Street					✓	✓					
677 East Broadway Street					✓	✓					
1648 East 1st Avenue					✓	✓					✓
518 Richards Street							✓				
2950 Prince Edward Street							✓				
119 East Cordova Street							✓			✓	✓
1210 Seymour Street								✓			
2610 Victoria Drive								✓			
21 East 5th Avenue								✓	✓		
862 Richards Street								✓	✓		
1647 East Pender Street										✓	
900 Pacific Street											✓



Panel Model to Measure the Effect of an Open Shelter

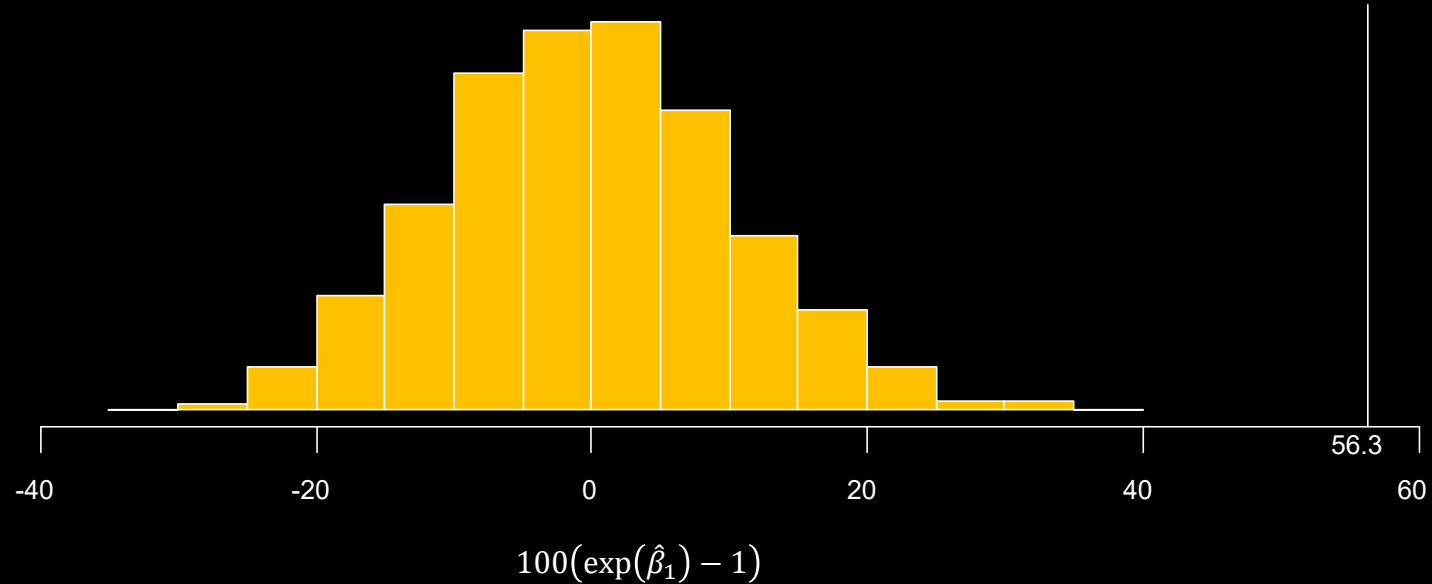


- $y_{it} \sim \text{Poisson}(\lambda_{it})$
- $\log(\lambda_{it}) = \beta_1 \text{shelter}_{it} + \alpha_i + \gamma_t$
- y_{it} is property crime count in region i in year t

Permutation Test Reshuffles the Shelter Timing Subject to a Fixed Column Margin

Shelter Address	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
134 East Cordova Street			✓		✓	✓			✓	✓	✓
51B W Cordova Street					✓						
320 Hastings Street					✓	✓	✓		✓		✓
201 Central Street										✓	
1442 Howe Street							✓	✓		✓	
1435 Granville Street						✓		✓	✓		
1642 West 4th Avenue				✓		✓		✓			✓
747 Cardero Street									✓		
677 East Broadway Street				✓	✓		✓				
1648 East 1st Avenue										✓	
518 Richards Street					✓	✓	✓				✓
2950 Prince Edward Street					✓	✓					
119 East Cordova Street				✓				✓		✓	
1210 Seymour Street				✓		✓	✓	✓			
2610 Victoria Drive					✓	✓	✓	✓	✓		
21 East 5th Avenue		✓		✓	✓			✓		✓	✓
862 Richards Street				✓			✓	✓			
1647 East Pender Street					✓						✓
900 Pacific Street						✓	✓		✓		✓

Shelter Associated with a 56% Increase in Property Crime with 100m



Shelter Associated with a 56% Property Crime Increase

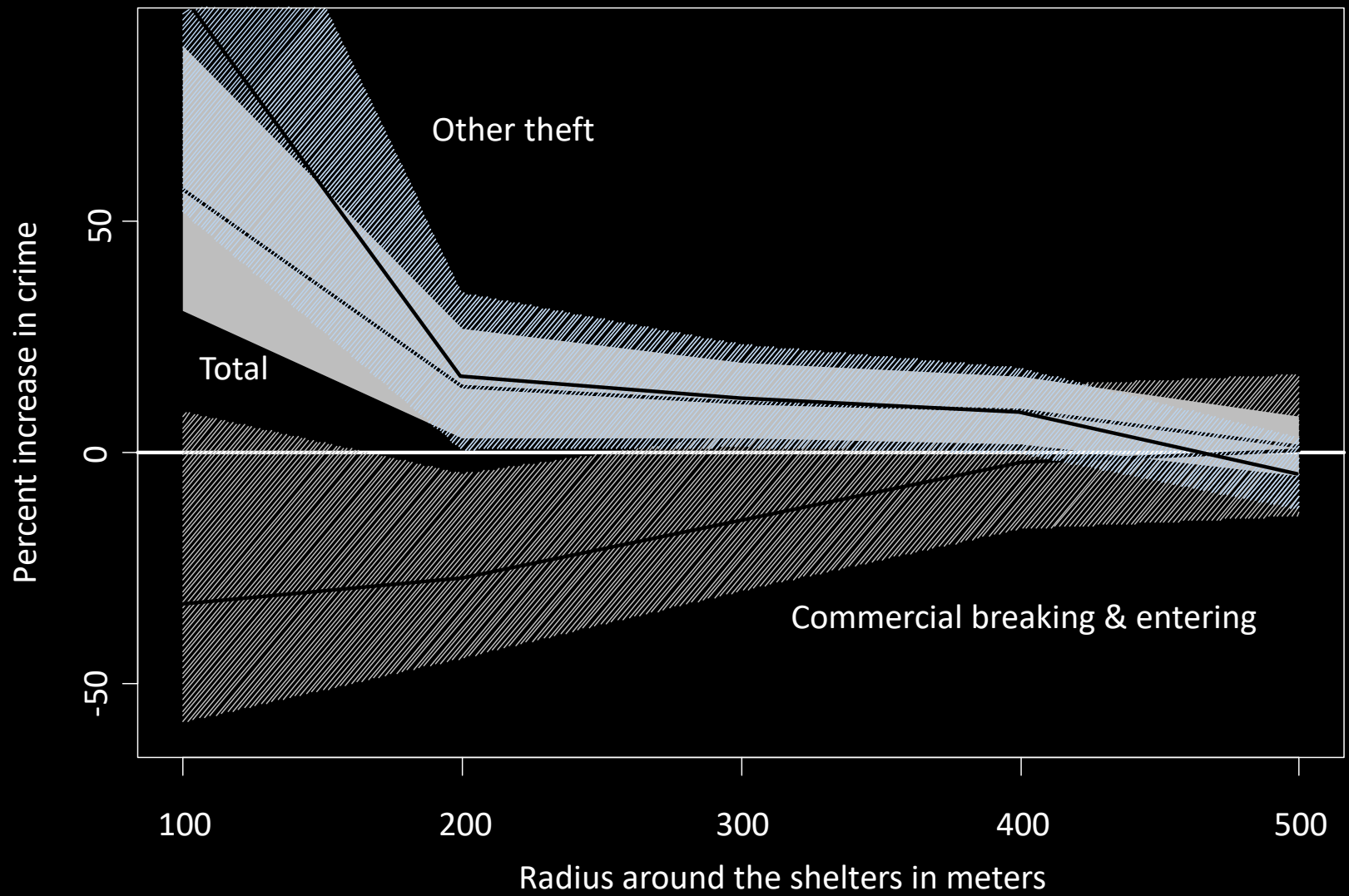
		Radius around shelters				
		100m				
Total Property and Mischief Crime		56.3 <0.001*				

Decreasing Effect with Increasing Radius

	Average crime count per winter within 300m of shelters	Radius around shelters				
		100m	200m	300m	400m	500m
Total Property and Mischief Crime	1780	56.3 <0.001*	14.0 0.005*	10.8 0.007*	8.7 0.009*	0.9 0.444

Decreasing Effect with Increasing Radius... Almost Always

	Average crime count per winter within 300m of shelters	Radius around shelters				
		100m	200m	300m	400m	500m
Total Property and Mischief Crime	1780	56.3 <0.001*	14.0 0.005*	10.8 0.007*	8.7 0.009*	0.9 0.444
Break and Enter Residential	75	82.5 0.009*	9.4 0.295	-0.7 0.430	-1.4 0.444	2.5 0.433
Break and Enter Commercial	137	-33.5 0.035	-27.1 0.001*	-14.9 0.040	-2.5 0.467	0.3 0.397
Theft from Vehicle	538	42.9 0.007*	15.8 0.024	20.7 <0.001*	15.1 0.012*	12.0 0.053
Theft of Vehicle	57	-39.9 0.059	-19.8 0.088	-2.4 0.376	-11.0 0.099	-9.5 0.157
Other Theft	709	98.1 <0.001*	16.4 0.023	11.5 0.015*	8.5 0.040	-5.1 0.104
Mischief	264	26.3 0.033	28.3 <0.001*	8.5 0.097	7.8 0.060	2.3 0.428



- Emergency winter homeless shelters in Vancouver
- Transit stations in Los Angeles
- Civil gang injunctions in Los Angeles
- Opiate treatment centers in Philadelphia

G. Ridgeway and J.M. MacDonald (2017). "Effect of Rail Transit on Crime: A Study of Los Angeles from 1988-2014," *Journal of Quantitative Criminology* 33(2):277-291.

Though Best Known for Freeways, Los Angeles Has Built an Extensive Rail System

- 1961 the last of the Pacific Electric rail lines ended service
- 1961-1990 Los Angeles was the largest city in the U.S. without a rail transit system
- 1990 Los Angeles opened the Blue Line
- 2014 Los Angeles had six lines covering 87 miles of service, carrying more than 300,000 daily riders



Los Angeles Presents a Special Opportunity to Assess the Effect of Transit on Crime

1. Data on crime trends cover the entire expansion of Metro Rail in the second largest U.S. city
2. The time series is nearly three decade long
3. Compare crime near stations before and after opening and with areas eventually having stations
4. Transit labor union went on a 32-day strike in 2000 and a 35-day strike in 2003



Data From 1988-2004 Collected from 2,300 Pages at LA Library

CMIS REPORT # 10

SELECTED CRIMES AND ATTEMPTS BY REPORTING DISTRICT
FIRST QUARTER REPORT 1990

CENTRAL

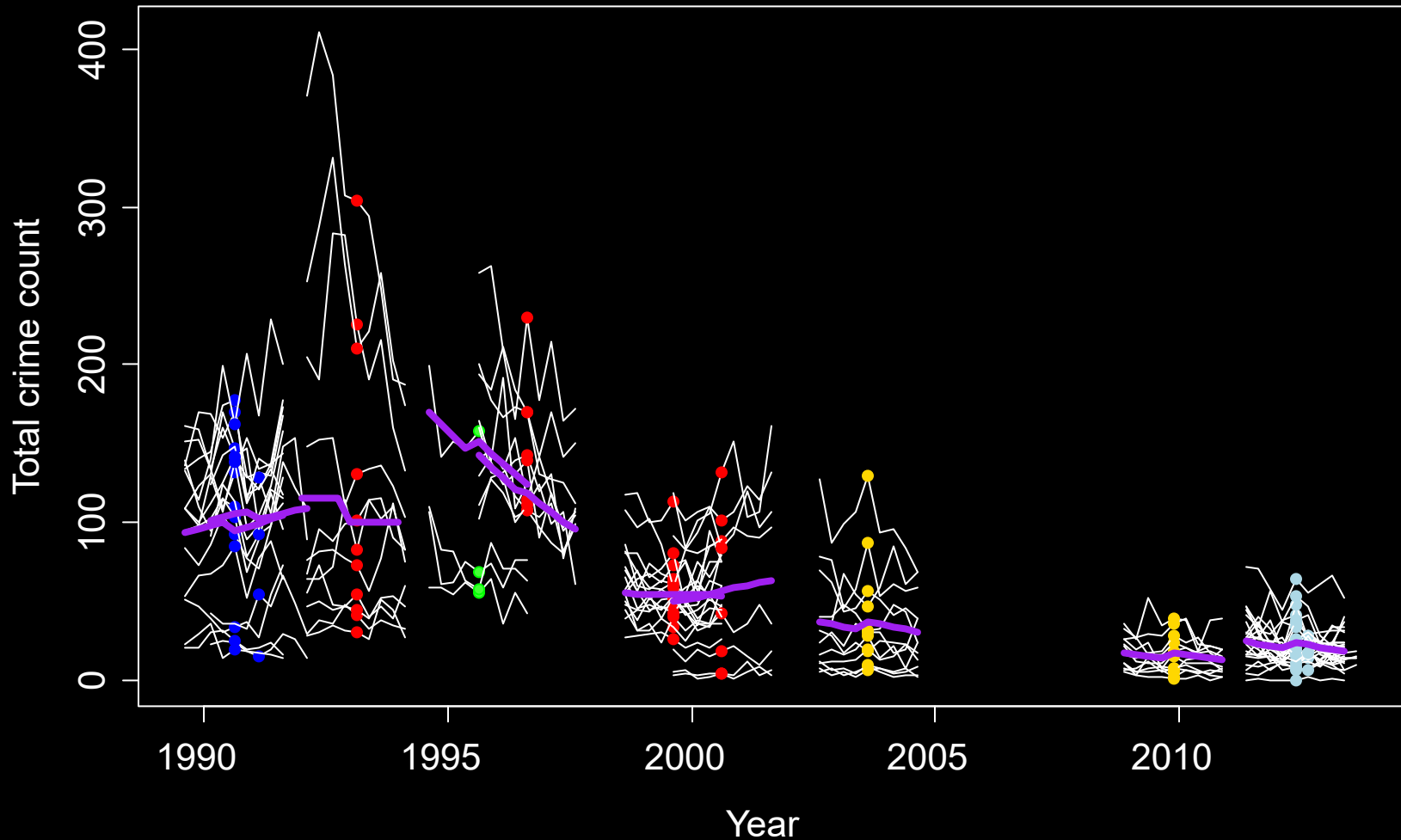
REPORTING DISTRICT	BURG BUS-	BURG RES-	BURG OTH-	ROBB ST-	ROBB OTH-	MURD-ER	RAPE	AGGR ASSA-ULT	BURG FROM AUTO	THEF FROM AUTO
0100	0	0	1	0	0	0	0	1	0	
0102	0	0	0	5	0	0	0	0	0	
0105	0	4	5	3	0	0	0	3	5	
0106	27	3	10	37	4	1	0	16	100	
0107	4	2	6	9	2	1	1	16	39	1
0110	0	0	0	0	0	0	0	0	0	
0111	1	0	1	2	0	0	0	5	3	
0112	0	3	4	0	0	0	0	0	4	
0114	1	0	1	17	1	0	1	7	57	
0118	2	1	0	2	0	0	0	2	32	
0122	0	6	0	0	0	0	0	0	6	
0124	1	5	1	1	3	0	0	1	65	
0125	4	0	2	6	1	0	0	4	20	
0127	5	0	3	4	1	0	1	2	13	
0128	1	2	2	2	2	0	0	5	25	
0129	1	0	4	1	1	0	1	0	18	
0131	0	1	0	1	0	0	0	2	5	
0132	4	5	8	6	3	0	0	3	39	
0133	21	1	0	11	0	0	0	10	15	
0136	3	0	1	27	0	1	0	18	17	

Reporting District Map of Central Area

FORM 17.01.00

- Data from 2005-2014 came from LAPD incident level crime data
- All data available at github.com/gregridgeway/LAPDcrimedata

Identification Strategy Relies on the Staged Rollout of Metro Rail over 30 Years



Isolate Effect of Transit Using Three Approaches

- *Stepped wedge design* – compare RDs with and without stations over time
- *Short term, station RDs only* – analyze only RDs with stations in the year before and after a station
- *Two labor strikes* – use the strikes to assess crime changes before, during, after the system shutdown

Isolate Effect of Transit Using Three Approaches

- *Stepped wedge design* – compare RDs with and without stations over time
- *Short term, station RDs only* – analyze only RDs with stations in the year before and after a station
- *Two labor strikes* – use the strikes to assess crime changes before, during, after the system shutdown

Stepped Wedge Design Detects Shifts in Crime Rates When Stations Open

$$\log(\lambda_{it}) \\ = \beta_0 + \beta_1 \text{station}_{it} + \alpha_i + \gamma'_{\text{division}(i)} ns_{15}(t)$$

- RDs have a station if the station is within 200m of the RD boundary
- 281 RDs within 1km of an eventual station
- 116 RDs will eventually have a station
- Computed permutation p-values by randomly exchanging station openings between RDs

Slight, Non-Significant Decline in Crime After Station Opening

Crime type	Average crime count per RD per year	% crime increase	Permutation p-value
Total	216.9	-2.6	0.21

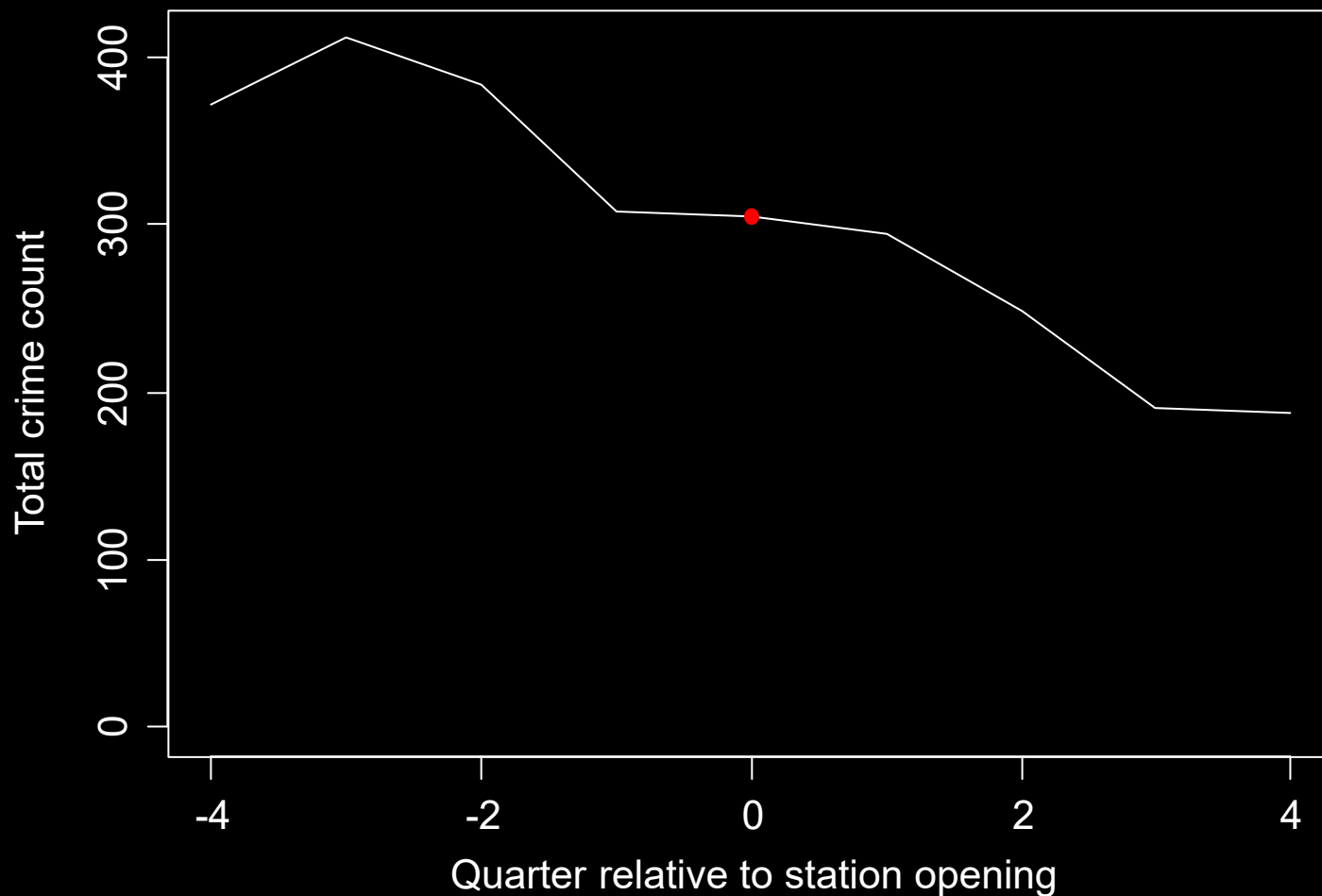
Most Crime Types Decline After Station Opening, None Significant

Crime type	Average crime count per RD per year	% crime increase	Permutation p-value
Total	216.9	-2.6	0.21
Assaults	39.8	-3.9	0.17
Burglary/theft from vehicle	58.3	-3.6	0.34
Burglary	34.5	-2.2	0.51
Auto theft	46.1	-3.8	0.17
Grand theft person	4.5	-6.9	0.35
Homicide	0.9	4.6	0.51
Robbery	32.8	-0.9	0.77

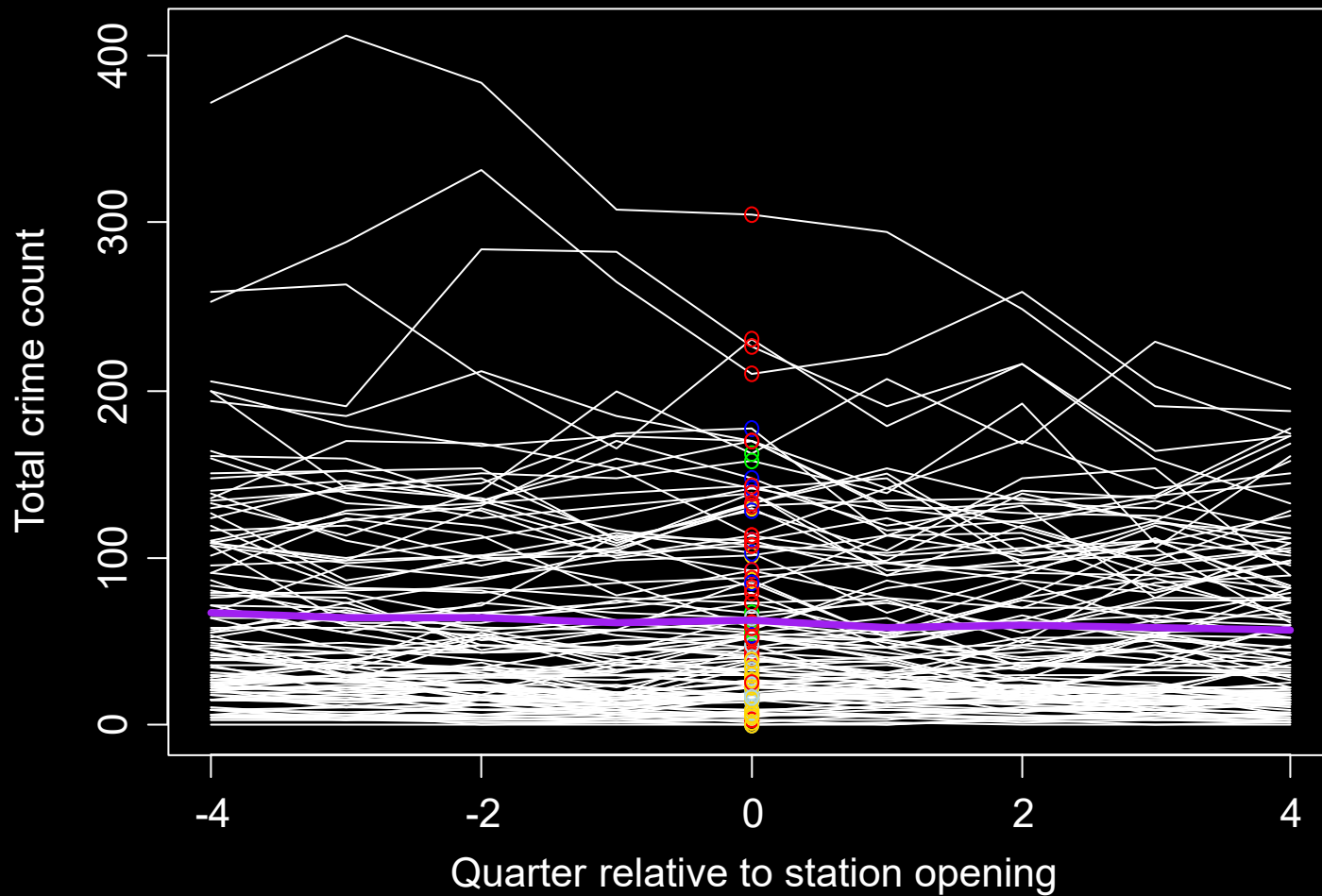
Isolate Effect of Transit Using Three Approaches

- *Stepped wedge design* – compare RDs with and without stations over time
- *Short term, station RDs only* – analyze only RDs with stations in the year before and after a station
- *Two labor strikes* – use the strikes to assess crime changes before, during, after the system shutdown

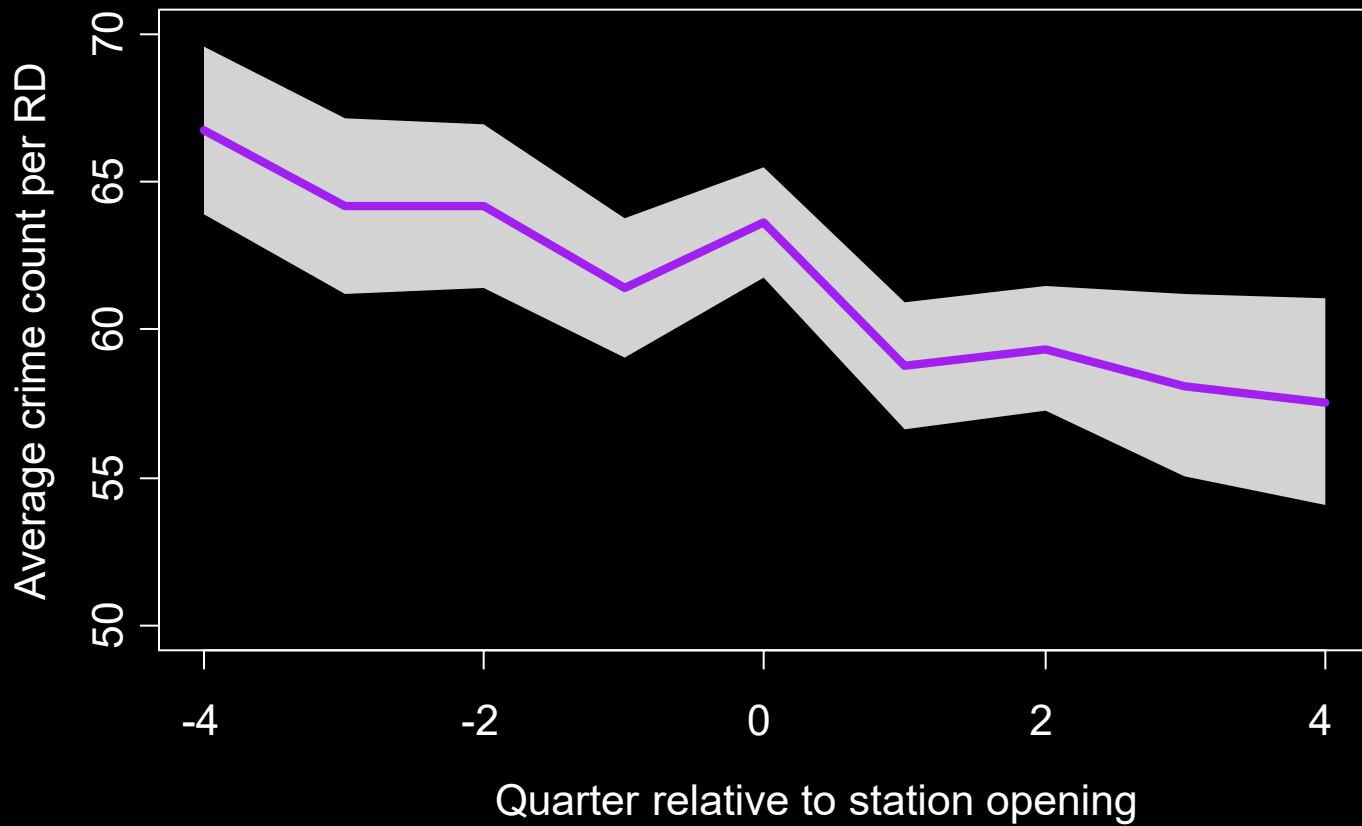
Examining Only Station RDs Avoids Confounding of Opening and Crime



Examining Only Station RDs Avoids Confounding of Opening and Crime



3% Increase When Station Opens, But Could Be Random



Station Openings Have a Minimal Effect on Crime

Crime type	% increase in crime when station opens	p-value		
Total	2.7	0.43		

P-values calculated by randomly selecting a different nine quarter sequence from the same RDs

Effect of Station Opening Does Not Vary by Distance to Station

Crime type	% increase in crime when station opens	p-value	% crime increase per km away from station	p-value
Total	2.7	0.43	0.1	0.50

No Strong Relationship Between Station Opening and Distance to Station

Crime type	% increase in crime when station opens	p-value	% crime increase per km away from station	p-value
Total	2.7	0.43	0.1	0.50
Assaults	-0.6	0.91	0.0	0.97
Burglary/theft from vehicle	5.6	0.40	0.0	0.95
Burglary	1.5	0.85	0.5	0.26
Auto theft	6.6	0.23	0.1	0.83
Grand theft person	-8.7	0.51	1.2	0.18
Homicide	-27.7	0.31	0.0	0.98
Robbery	0.6	0.92	0.1	0.88

Isolate Effect of Transit Using Three Approaches

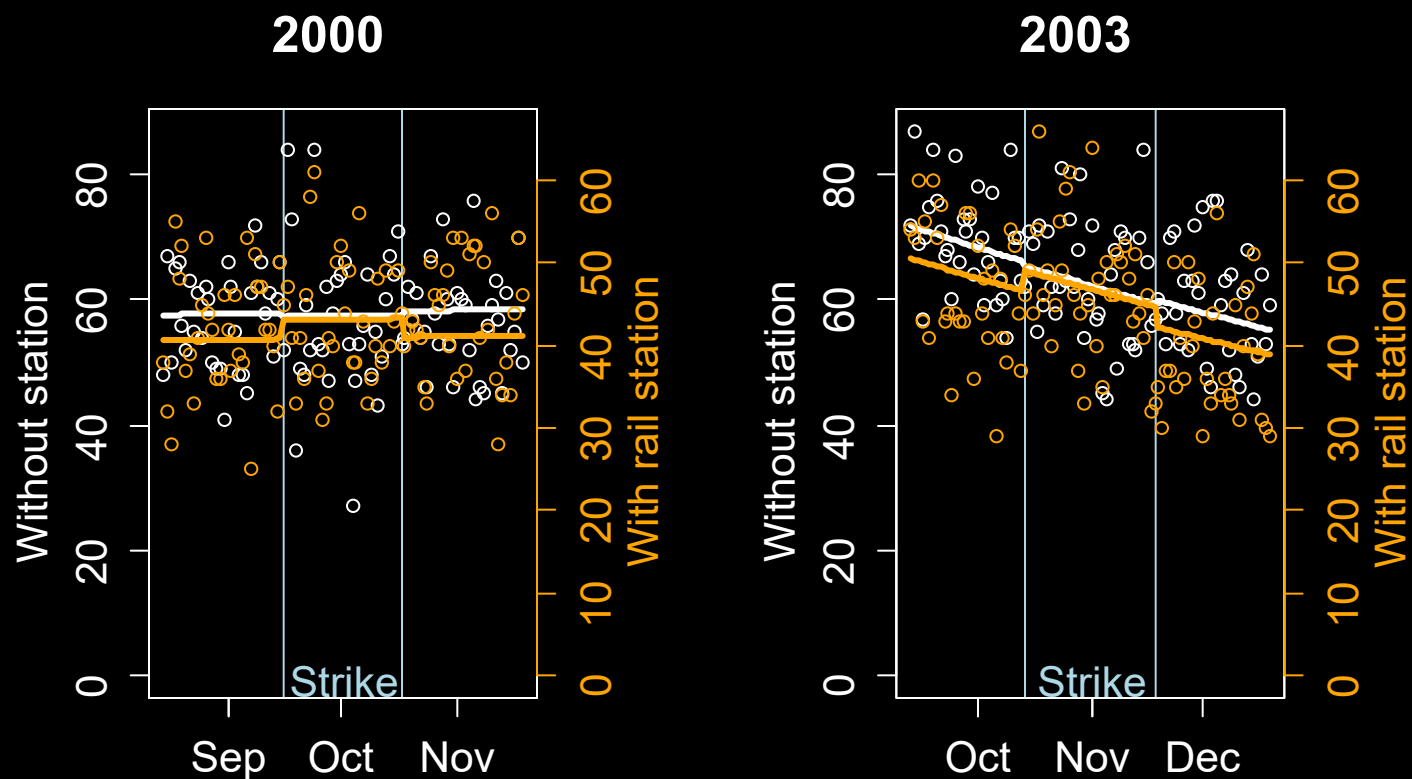
- *Stepped wedge design* – compare RDs with and without stations over time
- *Short term, station RDs only* – analyze only RDs with stations in the year before and after a station
- *Two labor strikes* – use the strikes to assess crime changes before, during, after the system shutdown

Strikes in 2000 and 2003 Shutdown Los Angeles Transit System

- 32-day strike from September 16-October 17, 2000
- 35-day strike ran from October 14-November 18, 2003
- Lo and Hall (2006) and Anderson(2014) showed strikes substantially disrupted transit



Crime Appears to Increase Near Stations During the Transit Strikes



Compare Strike and Non-strike Periods and Transit and Non-transit RDs

$$\log(\lambda_{it}) = \beta_0 + \beta_1 \text{transit}_i + \beta_2 \text{strike}_t + \\ \beta_3 \text{transit}_i \text{strike}_t + \\ \beta_4 I(\text{year}(t) = 2003) + \\ \beta_5 I(\text{year}(t) = 2000)t + \\ \beta_6 I(\text{year}(t) = 2003)t$$

$$\exp(\beta_3) = \frac{\frac{\lambda_{\text{transit,strike}}}{\lambda_{\text{transit,strike}}}}{\frac{\lambda_{\text{transit,strike}}}{\lambda_{\text{transit,strike}}}}$$

Some Signs of Crime Increases During the Strikes

Crime type	Relative increase in crime at stations during strike	95% CI	Permutation p-value
Total	1.07	(0.99, 1.14)	0.068
Assaults	1.02	(0.87, 1.21)	0.79
Burglary/theft from vehicle	1.10	(0.98, 1.24)	0.15
Burglary	1.13	(0.95, 1.34)	0.18
Auto theft	1.06	(0.92, 1.21)	0.46
Grand theft person	1.06	(0.66, 1.70)	0.83
Homicide	2.22	(0.76, 6.51)	0.17
Robbery	1.00	(0.84, 1.19)	0.99

- Emergency winter homeless shelters in Vancouver
- Transit stations in Los Angeles
- Civil gang injunctions in Los Angeles
- Opiate treatment centers in Philadelphia

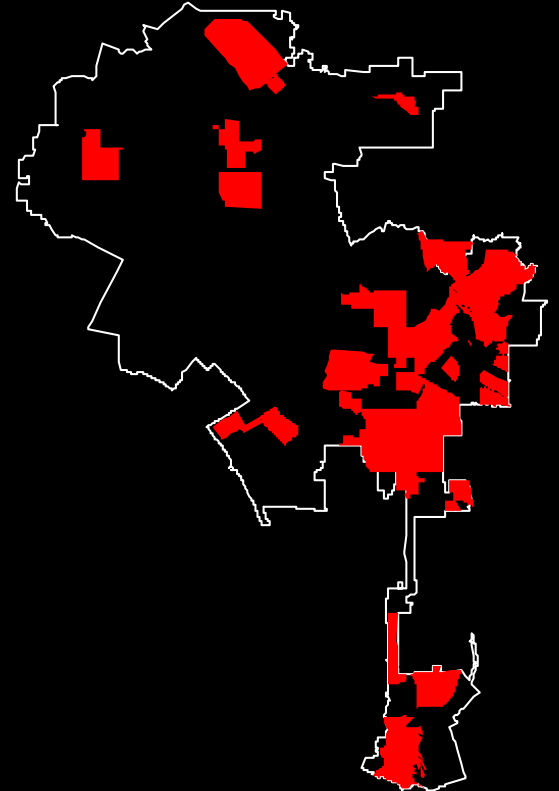
G. Ridgeway, J. Grogger, R.A. Moyer, and J.M. MacDonald (to appear). "Effect of Gang Injunctions on Crime: A Study of Los Angeles from 1988-2014," *Journal of Quantitative Criminology*.

Civil Gang Injunctions (CGIs) are Neighborhood-Focused Interventions

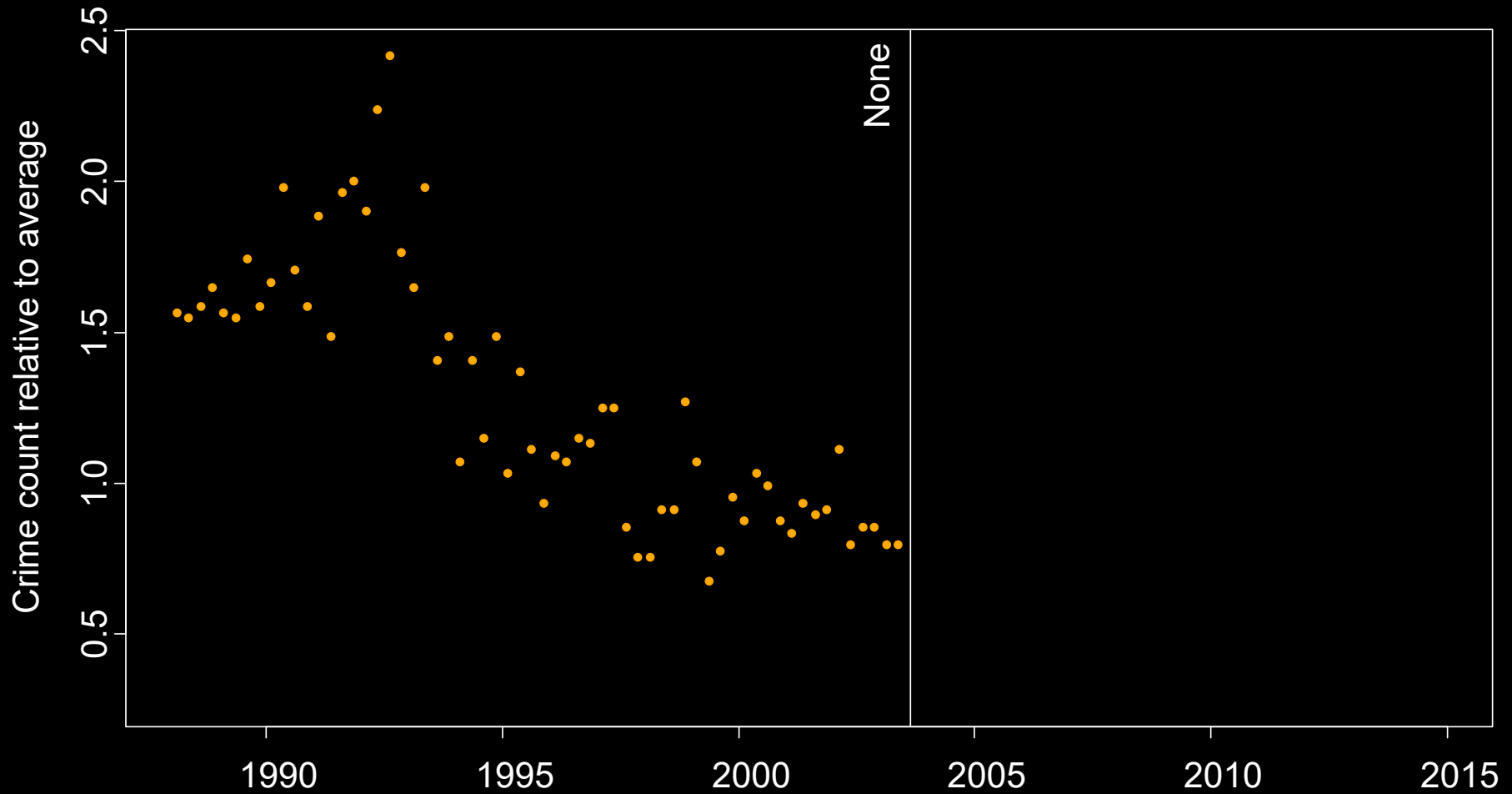
- Designed to interfere with routine behaviors of gang members within defined “safety zones”
- Civilly enjoin otherwise-legal activities
 - publicly congregating with other gang members
 - consuming alcohol
 - being outside after curfew
 - possessing spray paint

Los Angeles Provides Useful Framework to Assess CGI Effects

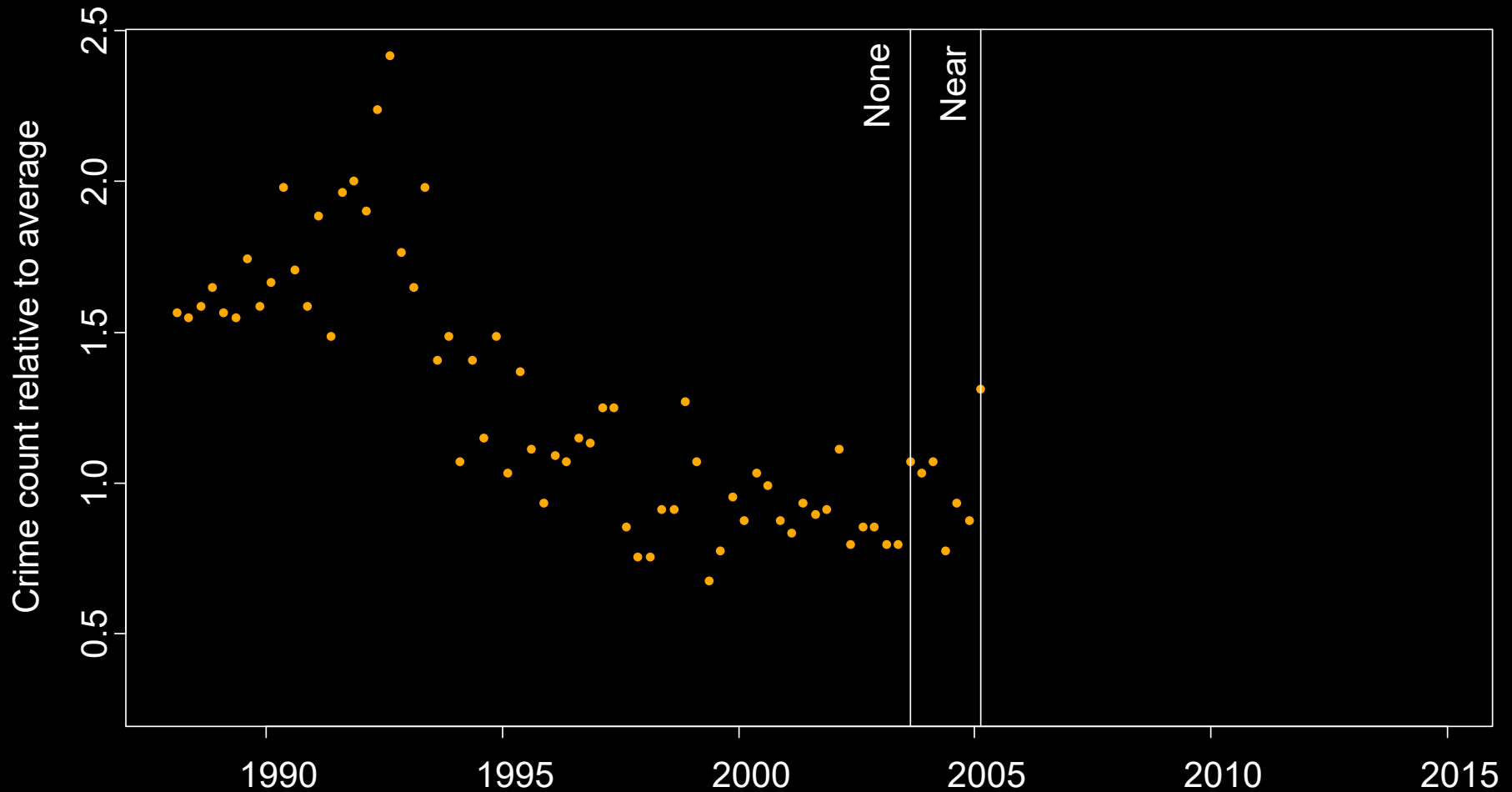
- LA historically has experienced severe gang-related crime
- 48 CGIs in effect in LA through 2014; 3 earlier CGIs terminated
- Any effects begin when complaint is served
- Our analysis uses quarterly LAPD crime reports (1988-2014)
- 939 RDs over 108 quarters
- In April 2018 a federal judge invalidated all gang injunctions



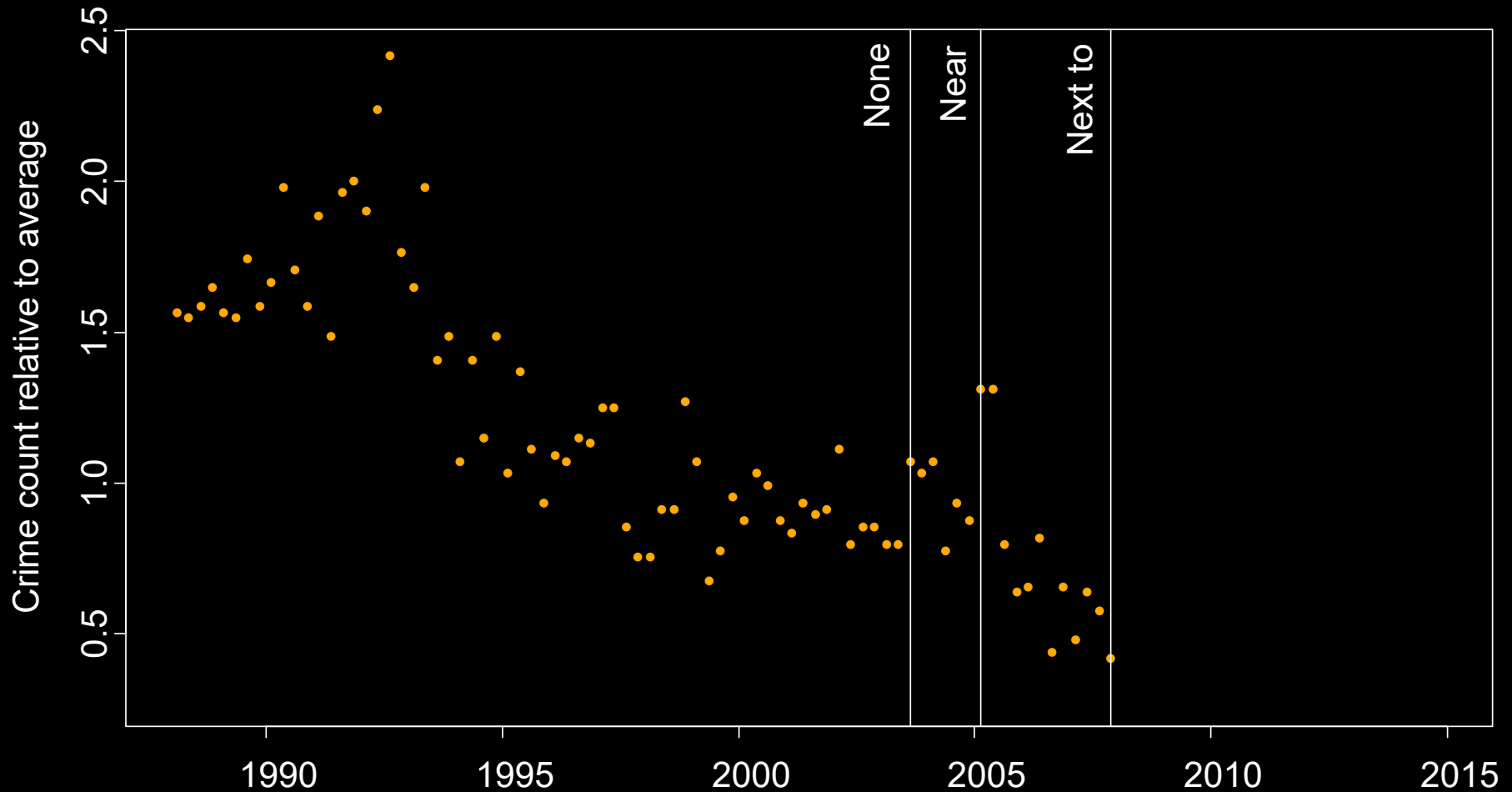
RD1204 Transitions from No Safety Zone, ...



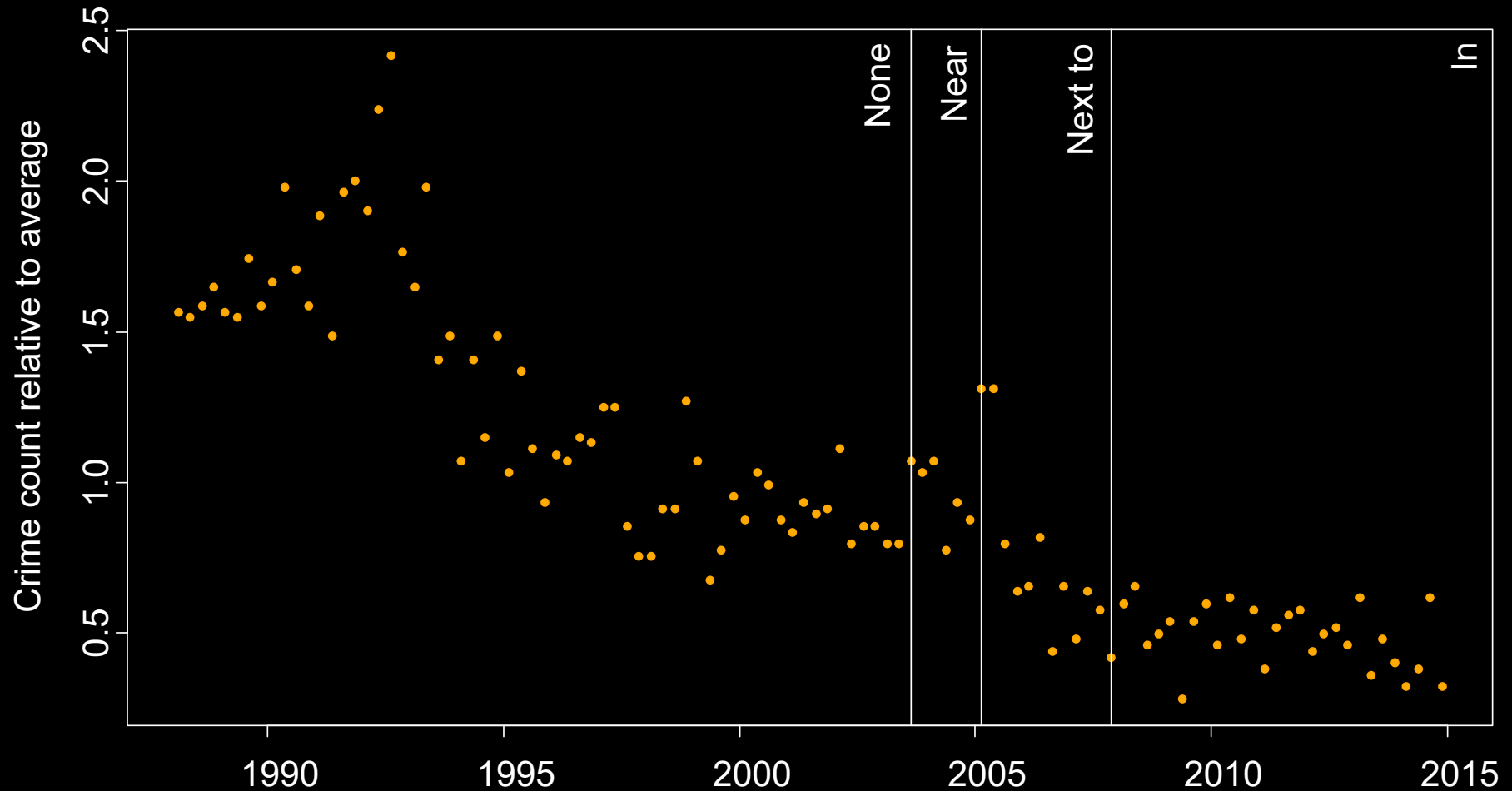
RD1204 Transitions from No Safety Zone, to Near, ...



RD1204 Transitions from No Safety Zone, to Near, Next to, ...



RD1204 Transitions from No Safety Zone, to Near, Next to, in a Safety Zone



Isolate Effect of CGI Using Three Approaches

- *Short term effect* – compare RDs in, adjacent to, and near CGI safety zones at the time of the CGI start ± 10 quarters
 - Clustered SEs at different levels
- *Long term effect* – compare RDs in, adjacent to, and near CGI safety zones across 27 years
 - Spatial covariance and clustered SEs for temporal correlation
- *Rampart scandal and case filing lapse* – assess crime changes before the CGI, during the CGI, when the CGI was suspended, and restarted
 - Permutation test

Isolate Effect of CGI Using Three Approaches

- *Short term effect* – compare RDs in, adjacent to, and near CGI safety zones at the time of the CGI start ± 10 quarters
 - Clustered SEs at different levels
- *Long term effect* – compare RDs in, adjacent to, and near CGI safety zones across 27 years
 - Spatial covariance and clustered SEs for temporal correlation
- *Rampart scandal and case filing lapse* – assess crime changes before the CGI, during the CGI, when the CGI was suspended, and restarted
 - Permutation test

Estimate the interaction between treatment and post-injunction

- $$Y_{idt} = \beta_1 D_{id} 1(t \geq 0) + \beta_2 S_{id} 1(t \geq 0) + \gamma_{\text{YearQuarter}(i,t)} + \mu_{id} + \varepsilon_{idt}$$
- For each injunction i , assemble RDs, d , in, next to, and near the safety zone
- Use only time period ± 10 quarters
- Bester, Conley, Hansen (2011) suggest computing clustered SEs at large levels (bureaus)

Two fewer crimes per quarter per RD in the safety zone, no spillover

		p-value with clustering by			
Total	Estimate	None	RD	Injunction	Bureau
Direct	-2.05	<0.001	<0.001	0.05	0.01
Spillover	-0.85	<0.001	0.16	0.23	0.34

Isolate Effect of CGI Using Three Approaches

- *Short term effect* – compare RDs in, adjacent to, and near CGI safety zones at the time of the CGI start ± 10 quarters
 - Clustered SEs at different levels
- ***Long term effect*** – compare RDs in, adjacent to, and near CGI safety zones across 27 years
 - Spatial covariance and clustered SEs for temporal correlation
- *Rampart scandal and case filing lapse* – assess crime changes before the CGI, during the CGI, when the CGI was suspended, and restarted
 - Permutation test

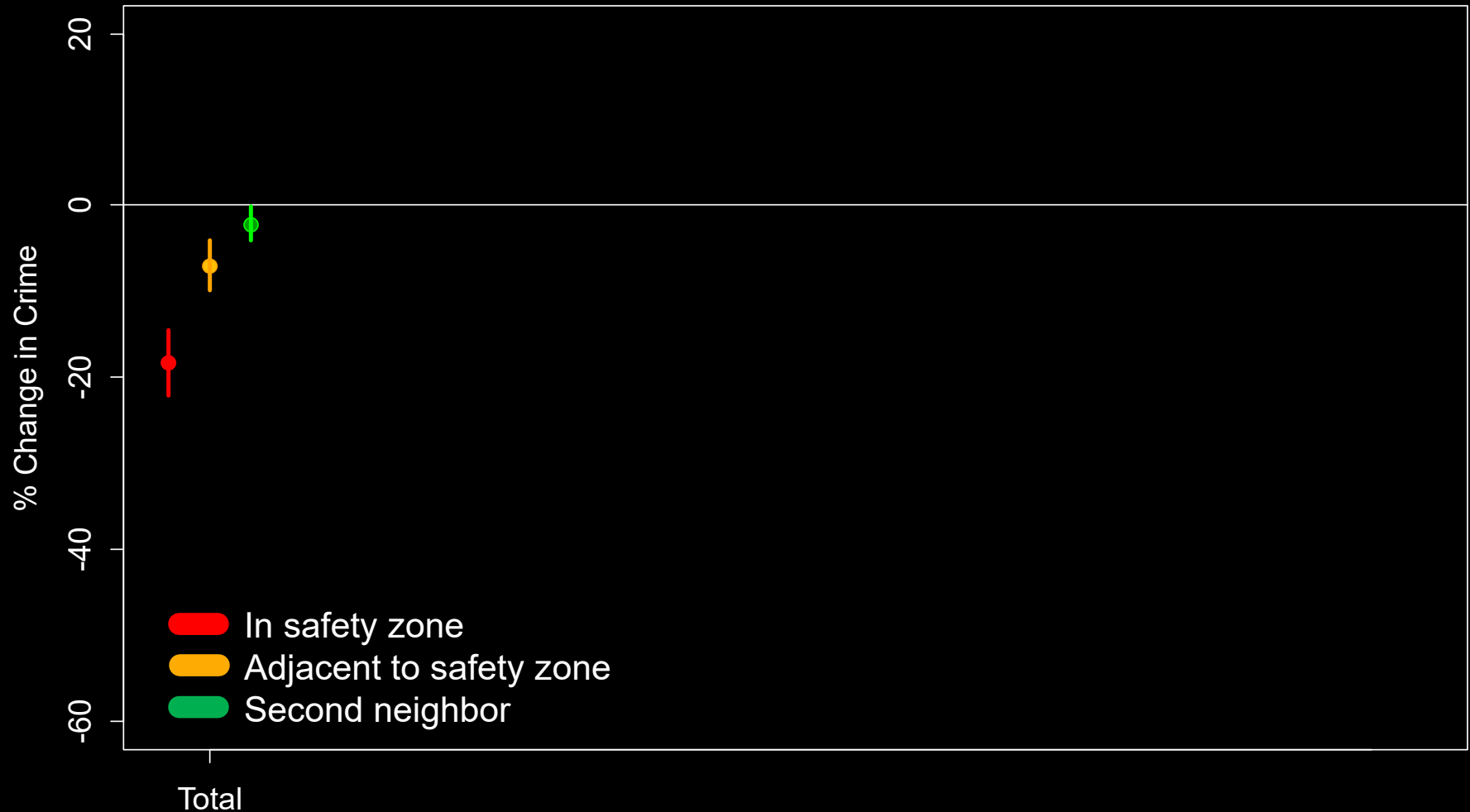
Stepped Wedge Design Detects Shifts in Crime Rates When CGIs Begin

$$Y_{dt} = \beta_1 D_{dt} + \beta_2 S_{dt} + \beta_3 C_{dt} + \gamma_t + u_d + \epsilon_{dt} + \lambda \sum_{j=1}^{701} w_{dj} \epsilon_{jt}$$

for $d = 1, \dots, 701, t = 1, \dots, 108$

- u_d is an RD fixed effect
- γ_t is a 108 quarter effect
- $w_{dj} = \frac{1}{n_d}$, RD d and RD j are adjacent

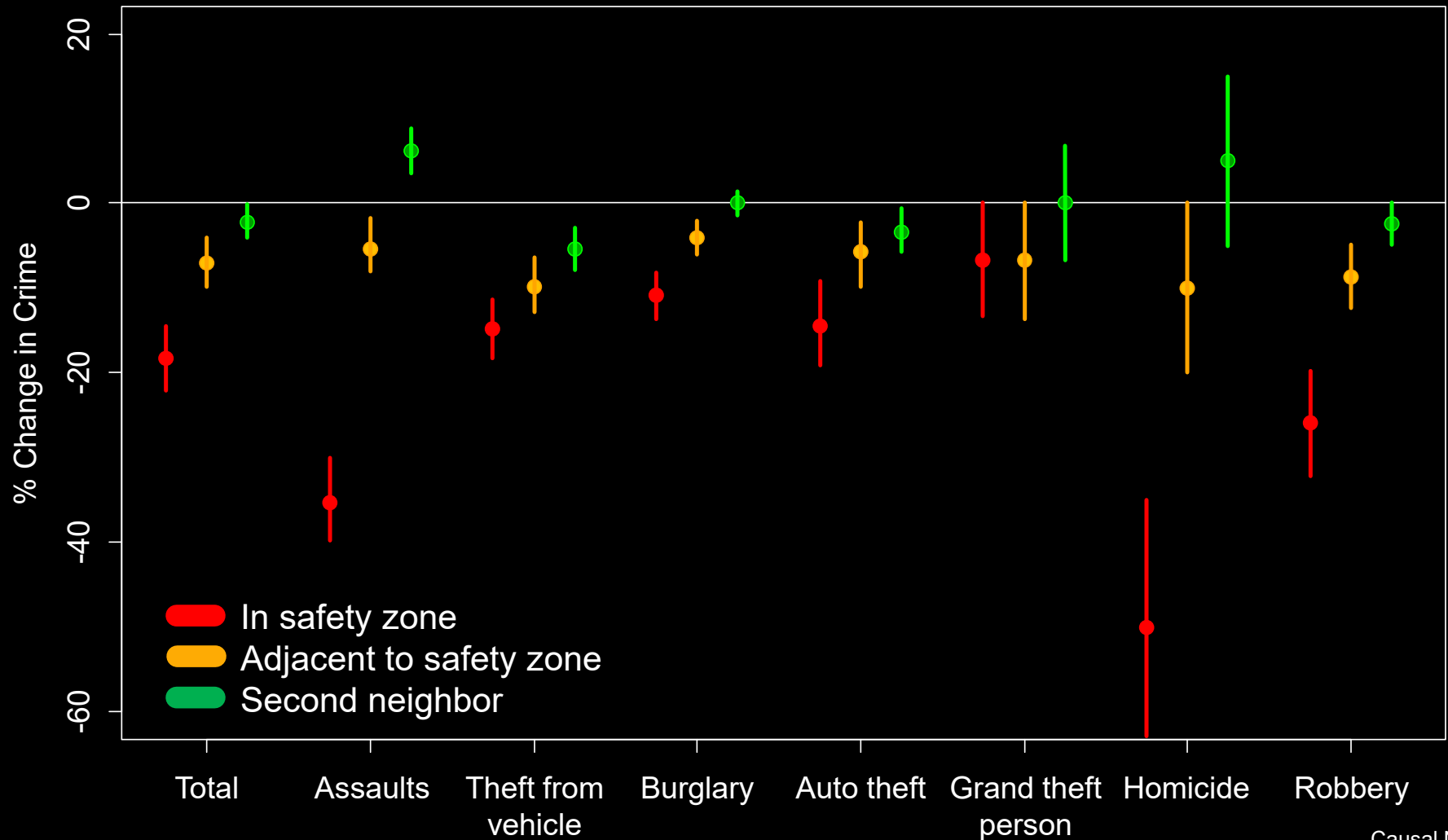
Neighborhoods Closest to Safety Zones See Largest Crime Decreases



Neighborhoods Closest to Safety Zones See Largest Crime Decreases



Neighborhoods Closest to Safety Zones See Largest Crime Decreases

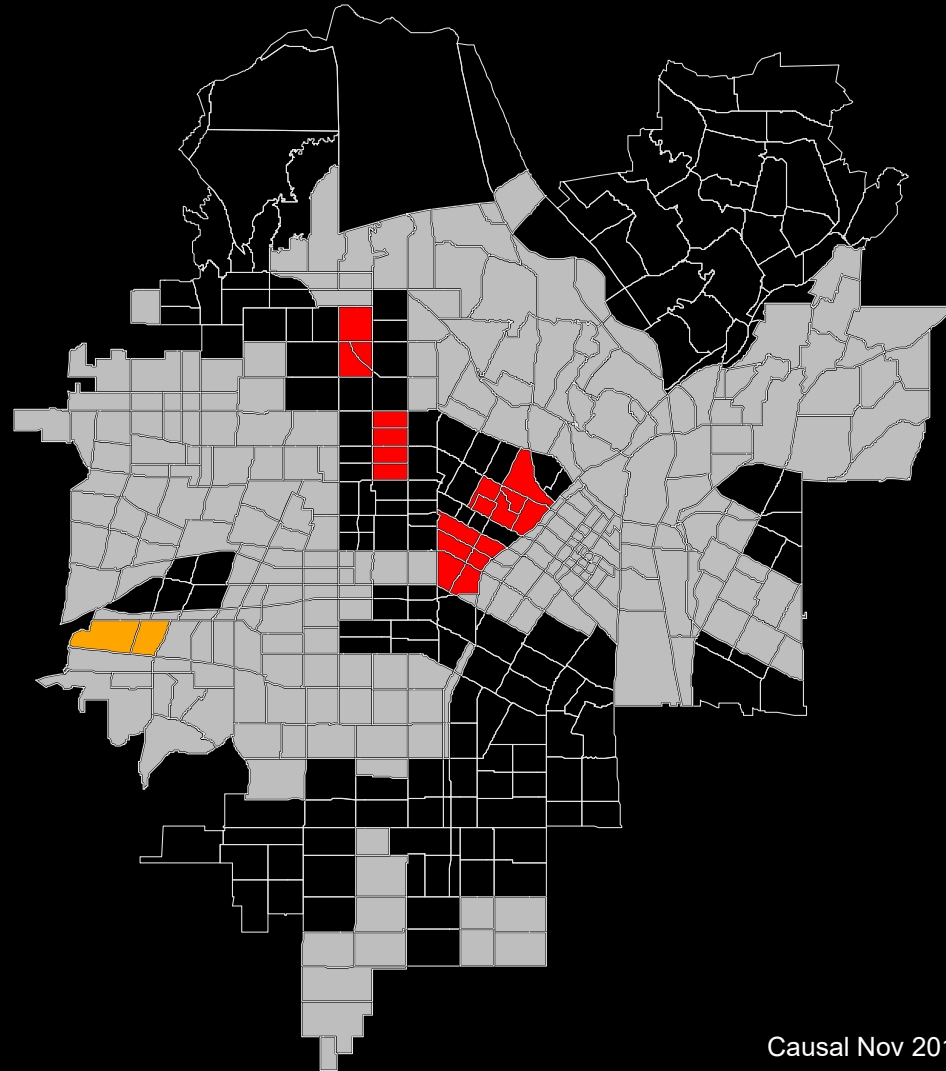


Isolate Effect of CGI Using Three Approaches

- *Short term effect* – compare RDs in, adjacent to, and near CGI safety zones at the time of the CGI start ± 10 quarters
 - Clustered SEs at different levels
- *Long term effect* – compare RDs in, adjacent to, and near CGI safety zones across 27 years
 - Spatial covariance and clustered SEs for temporal correlation
- *Rampart scandal and case filing lapse* – assess crime changes before the CGI, during the CGI, when the CGI was suspended, and restarted
 - Permutation test

Compare Disrupted Injunctions with Stable RDs Over Time

- Shatto Park, MS13, and Pico Union injunctions (red) disrupted
- Southwest injunction (orange) was continuous
- Other RDs had no injunction between 1996-2006



Use Change in CGI Status to Measure the Effect

$$Y_{dt} = \beta \text{active}_{dt} + u_d + \gamma_t + \epsilon_{dt}$$

- Use only data from 1996-2006
- active_{dt} indicates whether RD d 's injunction active
- u_d is an RD fixed effect
- γ_t is a 108 quarter effect
- Randomly shuffle active_{dt} across RDs

Evidence That CGIs Decrease Crime

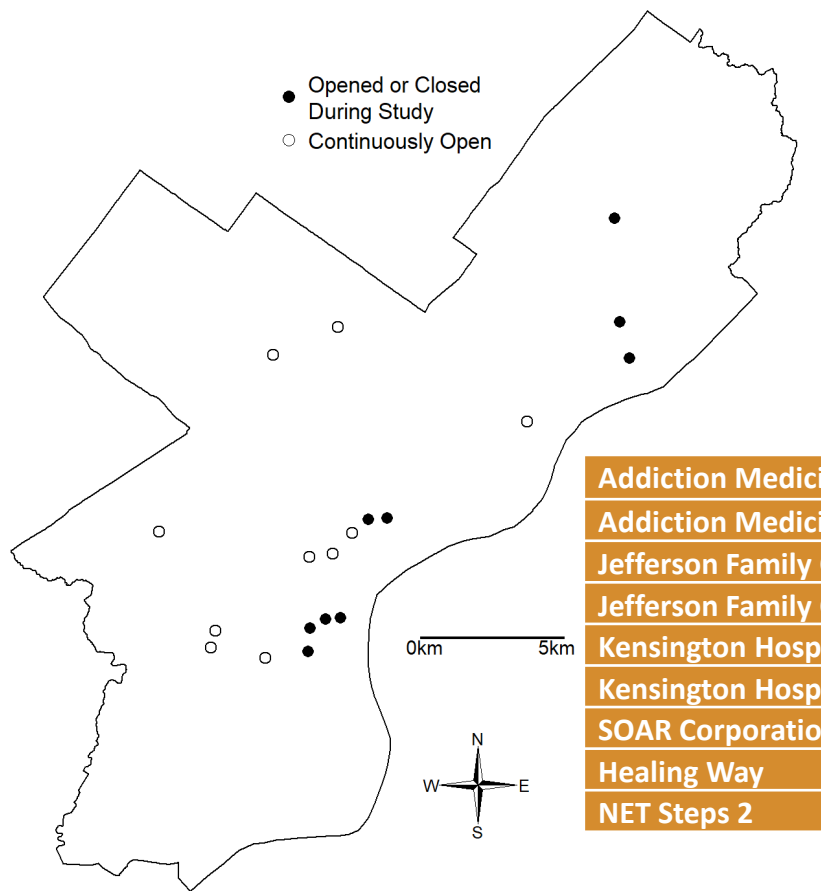
Crime type	Average number of crimes per quarter per RD	Increase in crime	Permutation test p-value
Total	54.5	-4.9	0.01

Evidence That CGIs Decrease Assaults, Homicide, Robbery

Crime type	Average number of crimes per quarter per RD	Increase in crime	Permutation test p-value
Total	54.5	-4.9	0.01
Assaults	14.3	-2.7	<0.001
Theft from vehicle	11.9	-0.3	0.64
Burglary	7.3	0.2	0.69
Auto theft	10.1	-0.5	0.38
Grand theft person	0.7	-0.1	0.26
Homicide	0.3	-0.1	<0.001
Robbery	9.9	-1.4	<0.001

- Emergency winter homeless shelters in Vancouver
- Transit stations in Los Angeles
- Civil gang injunctions in Los Angeles
- Opiate treatment centers in Philadelphia

R. Moyer and G. Ridgeway (to appear). "The Effect of Outpatient Methadone Maintenance Treatment Facilities on Place-Based Crime," *Journal of Experimental Criminology*.



Addiction Medicine	928 Market Street 19107	2009-2017	Center
Addiction Medicine	1200 Walnut Street 19107	2007-2008	Center
Jefferson Family Center	1233 Locust Street 19107	2008-2017	Center
Jefferson Family Center	1201 Chestnut Street 19107	2007	Center
Kensington Hospital	136 West Diamond Street 19122	2007-2015	North
Kensington Hospital	2100 Front Street 19122	2016-2017	North
SOAR Corporation	9150 Marshall Street 19114	2008-2017	Northeast
Healing Way	7900 Frankford Avenue 19136	2014-2017	Northeast
NET Steps 2	7520 State Road 19136	2015-2017	Northeast

What to do about geographic interventions?

Greg Ridgeway
Department of Criminology
Department of Statistics