GRYD INTERVENTION INCIDENT RESPONSE & GANG CRIME 2017 EVALUATION REPORT

THE CITY OF LOS ANGELES MAYOR'S OFFICE OF GANG REDUCTION AND YOUTH DEVELOPMENT (GRYD) RESEARCH AND EVALUATION TEAM

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Contents

List of Acronyms i
Introduction 1
Overview of the GRYD Comprehensive Strategy 1
An Overview of GRYD Intervention Incident Response 4
Evaluating the Impact of GRYD Intervention Incident Response on Gang Crime 6
An Overview of IR Incidents 10
GRYD IR Characteristics and Actions Taken 11
Assessing the Impact of GRYD IR on Retaliatory Gang Crime 15
The Challenge of Defining Gang Crime 21
Results 25
Analysis of Gang Crime and GRYD IR in South Los Angles GRYD Zones 26
Prevented Retaliations and the Cost of Gang Crime 29
Summary and Conclusion 31
Appendix 33

Table of Figures

Figure 1. GRYD Zones 2
Figure 2. Overview of the Comprehensive Strategy 3
Figure 3. GRYD Intervention Incident Response Logic Model 6
Figures 4A-D. Conceptual Model for Gang Violent Crimes in Time and Patterns of Retailation 16
Figure 5. Map of South Los Angeles Showing the Ten Contiguous GRYD Zones in Operation as of Mid-2015 24
Figure 6. Locations of GRYD IR Violent Crimes (purple) in a Comparable Six Month Period before (A) and after (B) the July 2015 Expansion of GRYD Zones in South Los Angeles – Time Periods Cover July-December 2014 (A) and July-December 2015 (B) 24
Figures 7A-C. Stotastic declustering of gang homicides and aggravatged assaults showing the location of background and retaliatory crimes. 28

Table of Tables

Table 1. Role and Responsibilities of Triangle Partners 5
Table 2. Type of Incident across Years 11
Table 3. GRYD RPC and CIW Actions Taken within the First 24 Hours across Years 12
Table 4. CIW Actions Taken by GRYD Zone within the First 24 Hours – 2015 Only 13
Table 5. Type of Contacts by GRYD RPC and CIW across Years 14

Table 6. Hypothesized Causal Patterns for Retaliatory Crimes 17
Table 7. GRYD IR Events Successfully and Unsuccessfully Matched with LAPD Reported Crimes 19
Table 8. Number of Violent Crimes where GRYD was Notified and Not Notified in 2014-2015* 19
Table 9. Number of Gang Violent Crimes where GRYD was Notified and Not Notified in 2014-2015* 20
Table 10. Numbers of Gang and Non-gang Violent Crimes Occurring in Los Angeles between 2012 and 2015 21
Table 11. Top 15 Gang Crime Types by Volume in 2014-2015 for All LAPD Data 22
Table 12. Gang Event Characteristics and the Classification of Gang Crimes 23
Table 13. Average Number of Gang Retaliations Triggered by GRYD IR Gang Crimes and by LAPD Gang Crimes City Wide 25
Table 14. Frequency of All Gang and Non-gang Violent Crimes in the South Los Angeles GRYD Zones in 2014-2105* 26
Table 15. Frequency of All Gang and Non-gang Crimes in the South Los Angeles GRYD Zones for which GRYD IR Received Notification in 2014-2015* 27
Table 16. Average Number of Gang Retaliations Triggered by GRYD IR Gang Crimes and by LAPD Gang Crimes in the South Los Angeles GRYD Zones 27
Table 17. Background and Retaliation Events by Crime Type for Combined LAPD-only and LAPD + GRYD IR Gang Crimes in South Los Angeles GRYD Zones During 2014-2015* 29
Table 18. Background and Retaliation Events by Crime Type for LAPD-only Gang Crimes in South Los Angeles GRYD Zones During 2014-2015* 29
Table 19. Background and Retaliation Events by Crime Type for LAPD + GRYD IR Gang Crimes in South Los Angeles GRYD Zones During 2014-2015* 29

List of Acronyms

CSULA	California State University, Los Angeles
CIW	Community Intervention Worker
ETO	Efforts to Outcomes
GRYD	City of Los Angeles Mayor's Office of Gang Reduction and Youth Development
IR	GRYD Intervention Incident Response
LAPD	Los Angeles Police Department
RPC	Regional Program Coordinator

Introduction

The City of Los Angeles Mayor's Office of Gang Reduction and Youth Development (GRYD) oversees a Comprehensive Strategy that involves the provision of prevention services, gang intervention services, violence interruption activities, and involvement in proactive peace-making activities (see Figure 2). GRYD is committed to evaluating these programs and currently contracts with California State University, Los Angeles to oversee all research and evaluation activities related to GRYD.

Denise Herz, Ph.D., in the School of Criminal Justice and Criminalistics oversees and directs the GRYD Research and Evaluation Team, which includes:

- California State University, Los Angeles: Molly Kraus, MPL; Kristine Chan, MSW; Carly Dierkhising, Ph.D.; and Akhila Ananth, Ph.D.
- Harder + Company Community Research: Loraine Park, MSW and Alfonso Martin, MA
- University of California, Los Angeles: Jorja Leap, Ph.D.; Laura Rivas, MSW/MPP; Kim Manos; P. Jeffrey Brantingham, Ph.D.; and Nick Sundback
- University of Southern California: Karen Hennigan, Ph.D. and Kathy Kolnick, Ph.D.
- University of Utah: Patricia Kerig, Ph.D.

These team partners work to evaluate the GRYD Comprehensive Strategy using both qualitative and quantitative data. Key goals of this work are to assess the impact of GRYD services and to create a "research to practice" feedback loop for continuous improvement of GRYD services. In addition to providing an overview of the Comprehensive Strategy and GRYD Intervention Incident Response (IR), this report presents evaluation results based on GRYD IR data collected between January 2014 and December 2015 and LAPD crime event data for the same time period.

Overview of the GRYD Comprehensive Strategy

The City of Los Angeles Mayor's Office of Gang Reduction and Youth Development (GRYD) was established in July of 2007 to address gang violence in a comprehensive and coordinated way throughout the City. Community-based service provision began in 2009. Over the years, GRYD developed and implemented a Comprehensive Strategy[1] to drive funding and practice decisions across areas designated as GRYD Zones. As shown in Figure 1, GRYD currently provides services in 23 GRYD Zones throughout the City of Los Angeles.[2]

[1] Cespedes, G., & Herz, D. C. (2011). The City of Los Angeles Mayor's Office of Gang Reduction and Youth Development (GRYD) Comprehensive Strategy. Los Angeles: GRYD Office.

[2] GRYD services began in 2009 in 12 GRYD Zones offering gang prevention, gang intervention, and violence interruption. An additional eight secondary areas offered more limited programming; four implementing only gang prevention and four gang intervention and violence interruption. As of July, 2015 GRYD has expanded to 23 full GRYD Zones in which all prongs of the comprehensive strategy are employed.

Figure 1. GRYD Zones

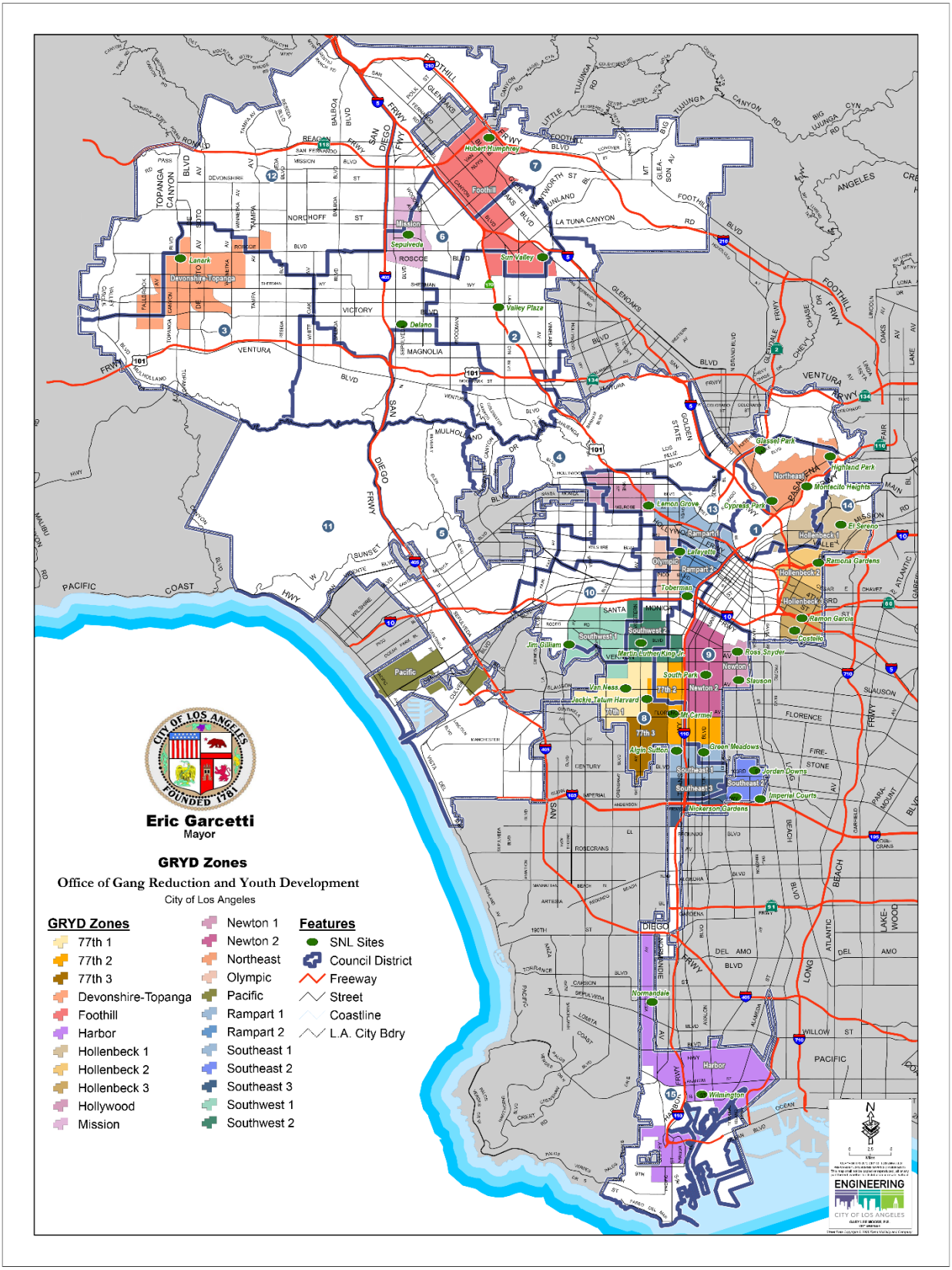


Figure 2 shows an overview of the programs and activities currently supported under the GRYD Comprehensive Strategy. Each of these programs and activities align with the following mission and goals:

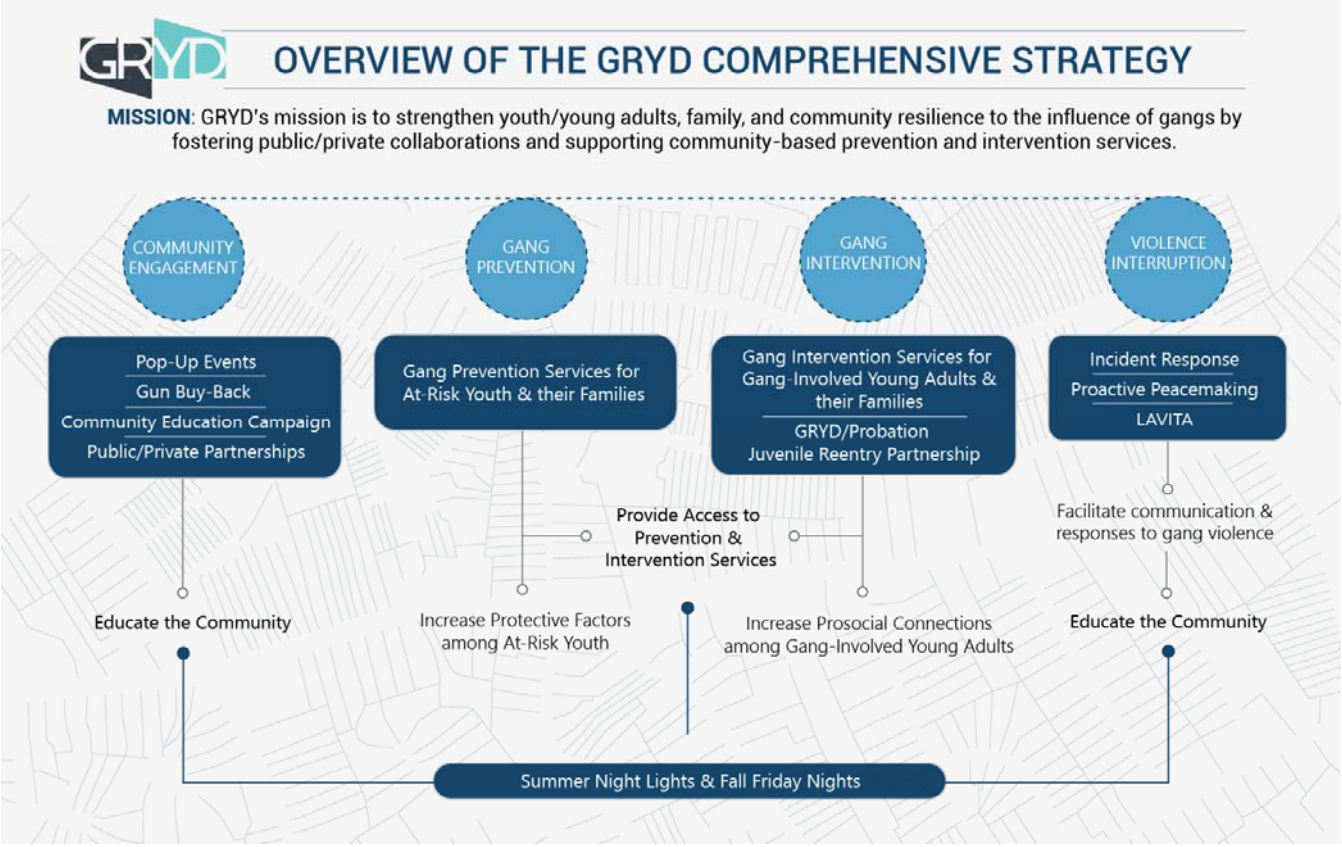
GRYD Comprehensive Strategy Mission

GRYD's mission is to strengthen the resiliency of youth/young adults, families, and communities to the influence of gangs by fostering public/private collaborations and supporting community-based prevention and intervention services.

GRYD Comprehensive Strategy Goals

- **Goal 1:** To increase the community's knowledge and capacity to effectively address gang involvement and violence.
- **Goal 2:** To increase protective factors and reduce gang joining among at-risk youth aged 10-15.
- **Goal 3:** To increase prosocial connections and other protective factors for gang-involved young adults between the ages of 14 and 25.
- **Goal 4:** To facilitate effective communication and coordinated responses to address gang violence.

Figure 2. Overview of the Comprehensive Strategy



As shown in Figure 2, the Comprehensive Strategy has multiple prongs, including community engagement, gang prevention, gang intervention and violence interruption. This report focuses on GRYD's violence interruption efforts when incidents occur in the community and also presents an analysis of gang-crime in Los Angeles and the potential impact of GRYD in disrupting gang violence. To begin, a brief description of GRYD Intervention Incident Response is provided.

An Overview of GRYD Intervention Incident Response

As part of GRYD's violence interruption efforts, GRYD Intervention Incident Response (IR) is designed to address gang violence both by responding to incidents when they occur and by engaging in ongoing proactive peacemaking efforts within the community (see Figure 3 for an overview of GRYD IR). GRYD's protocol involves coordination and communication between the GRYD Office, GRYD IR Providers, and the Los Angeles Police Department (LAPD). These partners, referred to as the "Triangle Partners", work together in a relational triangle to reduce the potential for retaliation following an incident and to support victims and families impacted by violence. The Triangle Partners:

- Gather and share information about incidents;
- Deploy and provide community response (e.g., diffusion of rumors, crowd control);
- Provide referrals to services (e.g., connection to GRYD services, victim assistance);
- Negotiate peace treaties/ceasefire agreements; and,
- Engage in proactive peacemaking activities and events (e.g., monitor hot-spots, conduct impact sessions).

This protocol combines the oversight and community organizing principles of the GRYD Office (through GRYD Regional Program Coordinators—RPCs), the assessment and implementation of intervention strategies based on community knowledge (through Community Intervention Workers—CIWs), and the investigative and targeted suppression strategies of law enforcement. The interaction among these entities affirms the roles and boundaries of each, while adding flexibility to each entity's response to incidents as they collectively work to reduce gang violence.

The GRYD Intervention Incident Response Protocol

GRYD RPCs and CIWs are on call 24/7 to respond to violent incidents that occur in and around GRYD Zones. Each GRYD RPC has designated GRYD Zones which they oversee and where they have developed relationships with the GRYD Prevention and Intervention Providers and law enforcement officers in each Zone. GRYD RPCs act as a conduit among and between law enforcement and Intervention Providers to ensure that accurate information is gathered and disseminated to both partners.

When a violent incident occurs, (typically these are homicides, shootings, or stabbings) and GRYD is notified, GRYD's initial response (within 24 hours of the incident) may vary based on the characteristics of the incident and the potential level of impact on the community. At initial response, GRYD may (1) respond to an incident via phone/or email, and/or (2) deploy to an incident location, such as an active crime scene, hospital, or place in the community. The level of response, or actions taken in response to an incident, depends on the assessment of the partners. The types of responses may include:

- **GRYD RPC Follows Up on the Incident (No CIW Action)**: GRYD RPC makes phone calls to *follow up* with LAPD about incidents, but limited information prevents further action from the GRYD RPC and CIW.
- **GRYD RPC Makes Phone Calls to Gather Information (No CIW Action)**: GRYD RPC makes phone calls and emails to *gather* information. CIW may be notified but no action will be taken (i.e., CIW actions are unable to mitigate post-incident dynamics).
- **GRYD RPC and CIW Takes Action**: Both GRYD RPCs and CIWs take some type of action (e.g., GRYD RPC makes phone calls to gather information and deploys to the scene; CIW deploys to the scene and connects the victim to victim assistance services).

Deployment to the scene or other places in the community may occur for one or more of the following reasons: for homicides, high profile incidents, information gathering, management requests, or areas where

there is spike in crime or tension between particular gangs. While the initial response occurs within the first 24 hours of an incident, additional actions may also be taken in the days and weeks that follow as new information is gathered. These additional post-incident follow-up actions may be taken to direct community engagement efforts towards neighborhoods impacted by violence, to link victims and their families to services, and to provide mediation between gangs if possible.

GRYD IR Goals

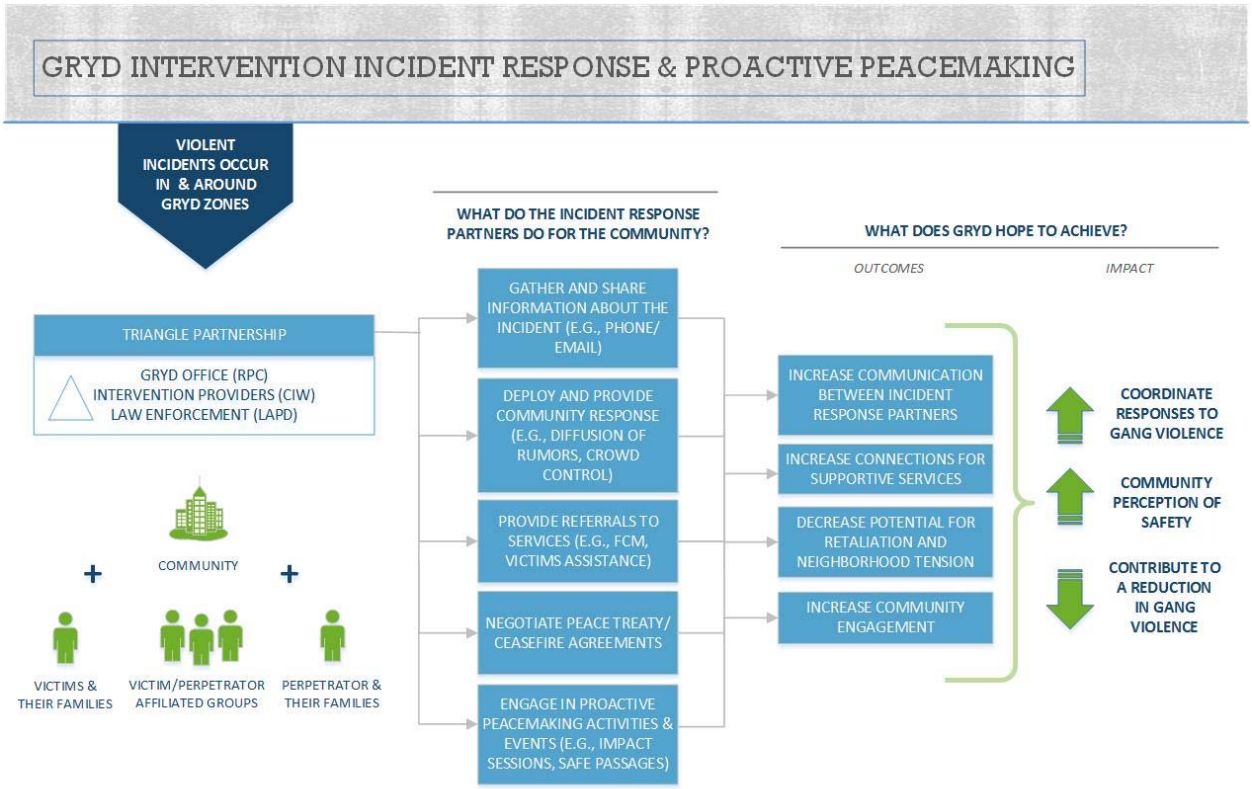
Two goals of GRYD's violence interruption activities are (1) to facilitate communication and responses to gang violence, and (2) to educate the community. These objectives are addressed through rumor control, crisis intervention, and other ongoing activities involving all Triangle Partners. Here, rumor control is defined as disseminating accurate information as quickly and widely throughout the community as possible. To prevent retaliation, CIWs are deployed to the community to provide crisis intervention. Although CIWs, LAPD, and GRYD RPCs work collaboratively to share information and support one another's work, the specific role each entity plays toward these objectives differs. The table below summarizes the responsibilities of each entity and how they complement one another.

Table 1. Role and Responsibilities of Triangle Partners

Partner	Rumor Control	Crisis Intervention	Ongoing Activities Involving All Partners
GRYD Regional Program Coordinator (RPC)	• Distribute facts to all GRYD Office staff and formal systems in the community (e.g., City Departments, City Council Offices, neighborhood organizations, etc.)	• Connect with the victim's family to determine if they need any immediate services • Communicate with schools, relevant City Departments, City Council Offices, and neighbors	• LAPD/GRYD Partnership Meetings
Community Intervention Worker (CIW)	• Distribute facts to the community through informal networks	• Connect with victim's family to determine if they need any immediate services • Canvass the community to assess the temperature of the community and determine level of retaliation • Engage in "street mediation" in order to defuse or de-escalate additional violence	
Law Enforcement	• Distribute facts to all gang units	• Stabilize the crime scene • Hold community meetings	

In addition to responding when incidents occur, CIWs also spend a significant amount of time in communities through proactive peacemaking efforts. These efforts aim to reduce violence in communities by conducting or participating in activities related to violence interruption.

Figure 3. GRYD Intervention Incident Response Logic Model



Evaluating the Impact of GRYD Intervention Incident Response on Gang Crime

To evaluate the potential impact of GRYD Intervention Incident Response (IR) it is imperative to understand how gang violence works on the ground and how GRYD IR is in a position to disrupt those interpersonal and also intergroup dynamics. Understanding how GRYD IR may impact gang violence in this report differs substantially from previous evaluations of GRYD IR.[3] In prior evaluations, the Urban Institute adopted two primary analytical approaches. Time series analyses were used to assess whether GRYD Zones outperformed forecasts based on pre-GRYD crime trends. Gang crime volume in primary GRYD Zones were also compared to control areas selected from Los Angeles County locations outside the purview of GRYD services. These analyses generally showed GRYD Zones did not outperform other areas of The City of Los Angeles in gang violent crime declines, but did modestly beat comparison areas in Los Angeles County.

[3] Dunworth, T., Hayeslip, D., Lowry, S., Kim, K., Kotonias, C., & Pacifici, L. (2013). *Evaluation of the Los Angeles Gang Reduction and Youth Development Program year 3 final report.* The Urban Institute and Harder + Company Community Research; Cahill, M., Jannetta, J., Tiry, E., Lowry, S., Becker-Cohen, M., Paddock, E., Serakos, M., Park, L., & Hennigan, K. (2015). *Evaluation of the Los Angeles Gang Reduction and Youth Development Program year 4 evaluation report.* The Urban Institute and Harder + Company Community Research.

There are a number of limitations with the prior analyses, several of which are acknowledged by the Urban Institute. Time-series forecasts can be used for measuring the performance of interventions, but only so long as there are no fundamental changes to the state of the system occurring independently of the intervention. Unfortunately, after multiple years of crime decline in Los Angeles, both violent and gang crime have seen year-on-year increases in 2014 and 2015. Further increases are expected for 2016 once the data are aggregated. Time series models will need to be reformulated once more is known about this large-scale state change. Only then would it be possible to address how GRYD IR has impacted gang crime at an aggregate, city-wide scale.

Equally problematic is the challenge of finding comparison groups for GRYD Zones. As acknowledged by the Urban Institute[4], GRYD is preferentially deployed in areas where gang violence is most concentrated. The challenges facing GRYD IR are equally acute since it is preferentially informed about only the most serious violent crimes. GRYD is not an experimental framework where control areas can be used easily, say what would have happened in the absence of GRYD interventions. Looking to Los Angeles County for comparison areas, as was done in prior analyses, is worthwhile. However, matching control areas to GRYD Zones requires a level of situational detail about those areas that does not yet exist.

Standard analyses may also be looking for effects at the wrong scale. Time-series analyses and control-area comparisons typically look for changes in the average volume of gang violence before and after some exposure (or in one place that received exposure compared to another that did not)[5]. However, it may be unreasonable to expect to see such aggregate, macroscopic impacts given the scale of GRYD IR deployments. As documented in the later sections, with the exception of criminal homicide, GRYD receives notification in only a small fraction of violent crimes, including those that are deemed gang-related. No matter how much of an impact GRYD IR has in the immediate aftermath of a single-victim shooting or homicide, these effects will generally be diluted by the much larger volume of events that GRYD IR was not notified about and therefore cannot respond to.

The overall conclusion is that short-term, local effects of GRYD IR interventions must be sought out, rather than global impacts. The relevant statistical models necessitate a close look at how gang violence operates at the scale of single events.

Current Approach to Understanding the Impact of GRYD IR on Gang Crime

Close inspection of any violent crime can often pinpoint the immediate causes of the event. Generally, these causes can be divided into two families. On the one hand are violent crimes that appear to be spontaneous, arising out of non-criminal social interactions. For example, a group of young men are hanging out at a party when one makes an offensive comment to another. A fist-fight ensues. While there was certainly a social grievance that prompted the fight, there is no prior recorded crime that precipitated the event. On the other hand, there are crimes that are visibly retaliatory. For example, an individual may seek revenge on behalf of a friend, who was shot and killed, by perpetrating their own aggravated assault against the perceived offenders[6]. While there was a grievance here too, there is also a prior recorded crime that serves as evidence of what precipitated the retaliation.

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[4] Dunworth, T., Hayeslip, D., Lowry, S., Kim, K., Kotonias, C., & Pacifici, L. (2013). *Evaluation of the Los Angeles Gang Reduction and Youth Development Program year 3 final report.* The Urban Institute and Harder + Company Community Research; Cahill, M., Jannetta, J., Tiry, E., Lowry, S., Becker-Cohen, M., Paddock, E., Serakos, M., Park, L., & Hennigan, K. (2015). *Evaluation of the Los Angeles Gang Reduction and Youth Development Program year 4 evaluation report.* The Urban Institute and Harder + Company Community Research.

[5] In experimental models the goal is to estimate the so-called average treatment effect (ATE). See Morgan, S. L, & Winship, C. (2015). *Counterfactuals and causal inference.* 2nd ed. Cambridge, England: Cambridge University Press.

[6] Anderson, E. (1999). *Code of the street: Decency, violence and the moral life of the inner city.* New York: Norton and Company; Jacobs, B. A., & Wright, R. T. (2006). *Street justice: Retaliation in the criminal underworld.* Cambridge University Press.

The potential for retaliation is not limited to certain crime types or certain individuals.[7] However, research shows that retaliation is a central feature of gang violence.[8] A general model for gang violence holds that some event precipitates a shooting by one gang against another. The shooting is spontaneous in the sense that some non-criminal cause is commonly at fault, such as a perceived insult or violation of a social norm (e.g., slippin'). The shooting may then prompt a retaliatory attack by the targeted gang. This crime is retaliatory in the sense that it is causally tied to the prior shooting. Several rounds of retaliation, back and forth between the gangs, may happen before things quiet down. What is distinct in the case of gang violence is that perceived insults or violations of social norms escalate more quickly to violence compared with similar violations in non-gang settings.[9] Rectifying perceived insults or responding to prior attacks is time-sensitive. In general, affronts to the reputation of the gang need to be dealt with swiftly and decisively, or the damage is done.[10] In addition, gang organization may magnify the risk of retaliation, as an offense against one member of a gang is often an offense against the gang as a whole.[11] Multiple individuals may thus seek to defend the name of the gang.

Decades of research underscore the importance of long-term social, economic and demographic factors in driving gang involvement.[12] But gang violence is also about short-term interactions and their consequences. The fictionalized vignette on the next page underscores the idea that today's gang homicide cannot be understood without reference to other recent events. It may be the consequence of recent conflicts between individuals and their affiliated gangs. It might also trigger new violence as individuals seek retribution on behalf of the victim and any perceived challenge to the gang.

This conceptual model of gang violence measured by gang retaliation events provides a practical target for GRYD IR. Spontaneous acts of violence may be difficult to prevent[13], but it may be possible to directly and measurably reduce the likelihood of retaliation. Knowing that retaliation is a strong possibility and that it is likely to happen soon after a triggering attack, GRYD can respond rapidly to try to mitigate the conditions that make retaliation possible.[14] Most importantly, using a model of retaliatory violence makes it possible to estimate the average number of retaliations generated by any gang crime GRYD IR is notified. This approach, however, is not without limitations. Most importantly, it must be acknowledged that GRYD IR by design is notified about only the most serious events–those that are most likely to lead to retaliation. As a result, comparison between sequences of events where GRYD IR is notified, and sequences where they are not, is likely to be biased against GRYD IR. GRYD IR may simply be fighting to bring the risk of retaliation back to "normal" levels, rather than eliminating such risk entirely.

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[7] There is evidence that property crimes such as burglary are sometimes committed in retribution. See Wright, R. T., & Decker, S. H. (1994). *Burglars on the Job: Streetlife and Residential Breakins.* Boston: Northeastern University Press.;

[8] Decker, S.H. (1996). Collective and normative features of gang violence. *Justice Quarterly,* 13, 243-264.; Papachristos, A. V. (2009). Murder by structure: Dominance relations and the social structure of gang homicide. *American Journal of Sociology*, 115(1), 74-128.; Papachristos, A. V., & Kirk, D. S. (2015). Changing the street dynamic. *Criminology & Public Policy*, 14(3), 525-558.

[9] Maxson, C. L. (2011). Street gangs. *In Crime and Public Policy*, edited by J. Q. Wilson and J. Petersilia. New York: Oxford University Press.

[10] Jacobs, B. A., & Wright, R. T. (2006). *Street justice: Retaliation in the criminal underworld.* Cambridge University Press.

[11] Decker, S. H., & Curry, D. G. (2002). Gangs, gang homicides, and gang loyalty: Organized crimes or disorganized criminals. *Journal of Criminal Justice,* 30(4), 343-352.

[12] Decker, S. H. (1996). Collective and normative features of gang violence. *Justice Quarterly,* 13, 243-264.; Pyrooz, D. C., Moule, R. K., & Decker, S. H. (2014). The contribution of gang membership to the victim–offender overlap. *Journal of Research in Crime and Delinquency*, 51(3), 315-348.

[13] Prevention of violence in the first place requires fundamental changes in culture, behavior and social systems that are the subject of GRYD Prevention and Intervention programs.

[14] Skogan, W. G., Hartnett, S. M., Bump, N., & Dubois, J. (2009). *Evaluation of ceasefire-Chicago.* Washington, D.C.: U.S. Department of Justice, Office of Justice Programs, National Institute of Justice.

John Doe was sitting in his car with two friends at the corner of Evergreen and Malabar around 11:30 PM on Friday, July 12, 2014. Two men approached the car. One pulled out a gun and shot John Doe three times. Neighbors heard the shots, called LAPD, and reported that the assailants made gang statements as they fled on foot towards Caesar Chavez Avenue. John Doe, just 17 years old, was pronounced dead at the scene. No one else in the car was hurt.

Not long after police reported to the scene, the Sergeant on duty in Hollenbeck Division called the GRYD Regional Program Coordinator (GRYD RPC) to discuss what was then known about the event. The GRYD RPC then reached out to the GRYD Intervention Provider in Hollenbeck and was put into contact with the Community Intervention Worker (CIW) working in the neighborhood in which the homicide took place. The CIW was well aware of a general uptick in gang activity in the area. After speaking again with LAPD Detectives on the scene, who thought this event was related to a drive-by shooting a few nights before, the RPC reported a high risk of further retaliatory violence based on the information gathered from LAPD and CIW.

The CIW spent the next day conducting rumor control about the incident. The provider made contact with the family of the victim to offer supportive services.

After two days without a shooting in or around the territory claimed by the assailants, GRYD and its partners in the community were cautiously optimistic that they reduced potential for retaliation.

In the next two chapters, an overview of IR incident characteristics is provided and the results for the retaliatory violence analysis are presented.

An Overview of IR Incidents

The goal of this evaluation is to better understand the City of Los Angeles Mayor's Office of Gang Reduction and Youth Development (GRYD) Intervention Incident Response (IR). This section provides an overview of all incidents reported to GRYD IR between January 1, 2014 and December 31, 2015. Data from the GRYD Efforts to Outcomes Database were used to provide a description of these incidents and the responses taken by GRYD staff and Community Intervention Workers (CIWs).

GRYD Efforts to Outcomes (ETO) Database

The GRYD ETO database tracks all instances where the GRYD Office was notified of a crime that could warrant GRYD IR intervention. There are multiple pathways through which such notification occurs including direct contact from an LAPD Patrol Division or LAPD Real-time Analysis and Critical Response (RACR) Division, daily State-of-The-City reports, or contact from a community member. The most common path for GRYD Office notification is through the LAPD Patrol Divisions or RACR. LAPD notifications are limited to violent incidents.

GRYD IR data includes information on crime type, location and time of event. These are the principal variables focused on for analysis. The GRYD ETO IR database includes the following crime types:

- Homicide
- Multiple Victim Shooting
- Single Victim Shooting
- Stabbing
- Shots Fired
- N/A or Unknown
- Other

These crime types do not align perfectly with LAPD (or California Penal Code) crime types. Single victim shooting, multiple victim shootings and stabbings in GRYD ETO data are all classified as aggravated assault (assault with a deadly weapon) in the LAPD data. GRYD crime types N/A or Unknown and Other can align in multiple ways with the LAPD. For events that have been successfully aligned with the LAPD data the LAPD crime type classification was adopted to ensure fair comparison with the entire LAPD dataset.

In addition to these basic pieces of information, the ETO database includes the GRYD Office's own evaluation of whether an event is a gang crime. Such an evaluation is separate from LAPD's determination, but is likely to be influenced by details relayed to GRYD Regional Program Coordinators (RPCs) by LAPD or Community Intervention Workers (CIWs). An inclusive approach was taken wherein any event was treated as a gang crime that either LAPD or GRYD labels as such.

The GRYD ETO database also includes information about the nature and extent of GRYD IR activity for each event. Dosage is critically important to understanding efficacy, but is complicated by the variation in field intervention tactics deployed in response to gang crime. Analysis of dosage data is not included in the present report. Future research will need to focus on methods for dosage measurement given the real-world circumstances at hand. Our approach therefore is to focus on instances where GRYD IR is notified of gang crimes regardless of the type of response that is delivered as a result of that notification. Notification is a logical necessity for GRYD IR to have any impact and focusing on notifications produces conservative hypothesis tests. Specifically, using notification as a marker of GRYD IR activity decreases the likelihood of

false positives (i.e., finding GRYD IR has an impact when in fact there was none), but increases the likelihood of false negatives (i.e., finding that there was no GRYD IR impact when in fact there was one).

GRYD IR Characteristics and Actions Taken

Out of the 1,536 notified IR incidents in two years matched to Los Angeles Police Department (LAPD) reported crimes, 792 (52%) incidents had some type of action taken by both the GRYD RPC and CIW. Within two years, the number of incidents where the full triangle protocol was enacted doubled from 266 incidents in 2014 to 526 incidents in 2015 (Table 2). The majority of incidents (77.9%) occurred inside GRYD Zones in both years, but after GRYD Zones were reorganized and expanded in 2015, intervention incident response covered larger areas designated as GRYD Zones. Approximately two thirds of incidents were single victim shootings, one-fifth of incidents were homicides, and a tenth were multiple victim shootings. A breakdown of these incidents by GRYD Zones is displayed in the Appendix. By 2015, the GRYD Zones that responded to the most incidents were: 77th 2, Mission, 77th 1, and Harbor.

Table 2. Type of Incident across Years

	2014 (N=266)		2015 (N=526)	
	N	%	N	%
Inside or Outside GRYD Zone				
Inside GRYD Zone	186	69.9	410	77.9
Outside GRYD Zone	79	29.7	116	22.1
Outside the City of Los Angeles	1	0.4	0	---
Type of Incident				
Homicide	69	25.9	123	23.4
Multiple Victim Shooting	26	9.8	45	8.6
Single Victim Shooting	168	63.2	348	66.2
Stabbing	2	0.8	3	0.6
Shots Fired	0	---	6	1.1
Other	1	0.4	1	0.2

After incident notification, GRYD RPCs and CIWs actions in the first 24 hours varied depending on the type of the incident and its characteristics. As displayed in Table 3, GRYD RPCs were more likely to make phone calls and send emails in order to relay information between partners. Over 2014 and 2015, GRYD RPCs were less likely to deploy to the scene, hospital, or community (25.2% to 9.1%). In contrast, across the years, CIWs were more likely to deploy to the scene, hospital, or community and were also more likely to have canvassed the community/provided outreach and controlled the diffusion of rumors.

Table 3. GRYD RPC and CIW Actions Taken within the First 24 Hours across Years

Actions Taken	2014				2015			
	GRYD RPC		CIW		GRYD RPC		CIW	
	N	%	N	%	N	%	N	%
Deployed to the Scene, Hospital, or Community	67	25.2	237	89.1	48	9.1	461	87.6
Phone Calls/Emails	250	94.0	224	84.2	507	96.4	408	77.6
Canvassed the Community/Outreach	0	---	196	73.7	0	---	333	63.3
Controlled the Diffusion of Rumors	0	---	154	57.9	0	---	313	59.5
Connected Victim/Victim's Family to Services	0	---	91	34.2	0	---	184	35.0
Crowd Control	0	---	26	9.8	0	---	31	5.9
Peace Treaty/Ceasefire	0	---	23	8.6	0	---	14	2.7
Other Actions	12	4.5	10	3.8	15	2.9	23	4.4

Note: Several actions may occur for one incident. Therefore, percentages do not sum to 100%.

Table 4 on the next page presents actions taken within the first 24 hours shown by GRYD Zones for incidents in 2015 only. Across GRYD Zones, CIWs were deployed to a place in the community for more than half of all incidents in each GRYD Zone with the exception of Southwest 2 (50.0%), Pacific (44.4%), and Southwest 1 (20.0%). These three GRYD Zones, however, were more likely to have conducted rumor control and have connected the victim/family to services. Connecting the victim/family to services took place for more than 80.0% of incidents in Southwest 1 (100.0%), Hollenbeck 1 (91.3%), and Hollenbeck 2 (83.3%). Crowd control occurred for 25.0% or less of all incidents across GRYD Zones and peace treaty negotiations occurred in only five GRYD Zones.

Table 4. CIW Actions Taken by GRYD Zone within the First 24 Hours – 2015 Only

GRYD Zone	N	Deployed	Canvassed Community	Rumor Control	Connected Victim/ Family to Services	Crowd Control	Peace Treaty
		%	%	%	%	%	%
77th 1**	46	89.1	69.6	69.6	26.1	6.5	2.2
77th 2	73	94.5	79.5	57.5	23.3	9.6	1.4
77th 3*	12	91.7	75.0	91.7	50.0	25.0	0
Devonshire-Topanga*	4	100.0	100.0	25.0	25.0	25.0	0
Foothill	31	93.5	64.5	38.7	38.7	3.2	0
Harbor	40	100.0	95.0	100.0	47.5	2.5	12.5
Hollenbeck 1	23	100.0	52.2	69.6	91.3	4.3	0
Hollenbeck 2*	6	100.0	50.0	66.7	83.3	16.7	0
Hollenbeck 3	16	100.0	37.5	25.0	68.8	0	0
Mission	50	94.0	66.0	50.0	50.0	4.0	8.0
Newton 1**	24	87.5	83.3	75.0	16.7	0	0
Newton 2*	24	91.7	50.0	41.7	58.3	8.3	12.5
Northeast**	29	96.6	51.7	20.7	24.1	0	0
Olympic*	9	88.9	44.4	33.3	22.2	0	0
Pacific	9	44.4	44.4	33.3	44.4	0	0
Proyecto Palabra	9	77.8	88.9	55.6	33.3	0	0
Rampart 1	19	94.7	94.7	73.7	36.8	10.5	0
Rampart 2	9	88.9	77.8	66.7	33.3	0	0
Southeast 1*	16	93.8	18.8	31.3	12.5	12.5	0
Southeast 2*	20	85.0	65.0	50.0	20.0	20.0	0
Southeast 3**	13	61.5	61.5	76.9	23.1	0	0
Southwest 1	10	20.0	10.0	80.0	100	0	0
Southwest 2**	34	50.0	14.7	82.4	5.9	2.9	0

* New GRYD Zones starting July 1, 2015
** Change in GRYD provider July 1, 2015

For incidents to which GRYD resources were applied, a variety of contact took place depending on who was taking action (Table 5). GRYD RPCs were in contact with LAPD within the first 24 hours. Conversely, CIWs were more likely to be in contact with the victim's family, the victim/perpetrator gangs, and LAPD across both years. Contact with victim's family was highest for Hollenbeck 2 (100.0%), Hollenbeck 1 (91.3%), and Mission (70.0%). Additionally, contact with victim or perpetrator's gang was highest for 77th 1 (82.6%),

Harbor (75.0%), and Rampart 2 (44.4%). The top three types of contact made following an incident by GRYD Zones are shown in the Appendix for 2015 only.

Table 5. Type of Contacts by GRYD RPC and CIW across Years

Type of Contacts	2014				2015			
	GRYD RPC		CIW		GRYD RPC		CIW	
	N	%	N	%	N	%	N	%
Contact Victim's Family	21	7.9	105	39.5	6	1.1	234	44.5
Contact with Victim or Perpetrator's Gang	21	7.9	80	30.1	7	1.3	163	31.0
Contact LAPD	260	97.7	83	31.2	496	94.3	152	28.9
Other	52	19.5	34	12.8	99	18.8	63	12.0
Contact Council Office	22	8.3	22	8.3	10	1.9	22	4.2
Contact Perpetrator's Family	1	0.4	15	5.6	0	---	23	4.4
Contact LAUSD	2	0.8	4	1.5	4	0.8	11	2.1

The incidents described in the next section were used in conjunction with LAPD data to assess the impact of GRYD IR on retaliatory gang crime. Results from these analyses are presented in the next section.

Assessing the Impact of GRYD IR on Retaliatory Gang Crime

This chapter examines the impact of GRYD Intervention Incident Response (IR) on gang crime using the retaliatory gang crime model described in earlier sections. As noted earlier, the prevalence of retaliation distinguishes gang from non-gang violence. Frequently, attributions of retaliatory violence are made on the basis of qualitative information such as knowledge of victims and suspects involved, their known or suspected gang affiliations, recent history of interactions, and rumors within the community.

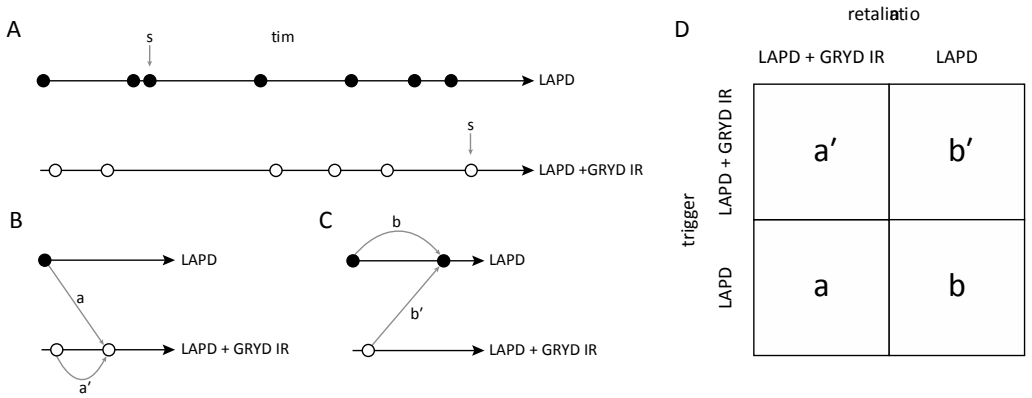
Here, a statistical definition of retaliation based on analysis of the known history of events was used[15]. The central idea is that an event is retaliatory when it can be statistically shown to be caused by one or more prior events. By contrast, a crime is not retaliatory if it can be shown that it is statistically independent[16] of all other events. Non-retaliatory crimes may sometimes be referred to as background events. As a practical matter, retaliatory events were expected to occur closer in time to one another (and nearby to one another in space) than background events that are statistically independent of one another[17]. Note that this method for identifying retaliatory and non-retaliatory crimes does not rely on evaluation of any contextual details such as information about the individuals' involved or explicit knowledge about retaliatory motives surrounding the crimes.

Over a collection of crimes, it is possible to statistically classify each and every event as either retaliatory or background (non-retaliatory) using statistical methods.[18] Given a classification for every event, the strength of retaliation was measured as the average number of retaliations (crimes) generated by any one crime. In general, 'garden variety' non-gang violent crime events were expected to generate relatively few retaliations. Gang violent crime was expected to generate on average more retaliations. The key evaluation question is what impact does GRYD IR have on the estimated numbers of retaliations.

Figures 4 A-D illustrate the model of gang violent crimes through time and key patterns of retaliation that may be measured with the data on hand. Gang violent crimes occurring through time can be divided into two types of events (Figure 4A). Some of these events are reported only to the LAPD. Other events are reported both to the LAPD and to GRYD IR.

[15] The statistical procedures are described in a technical appendix to this report.
[16] Two crimes are statistically independent when the waiting time between them (and if relevant the distance between crime locations) is not different from what would be expected if those events occurred completely at random.
[17] Short, M. B., D'Orsogna, M. R., Brantingham, P. J., & Tita, G. E. (2009). Measuring and modeling repeat and near-repeat burglary effects. *J. Quant. Criminol,* 25, 325-339.
[18] Zhuang, J., Ogata, Y., & Vere-Jones, D. (2002). Stochastic declustering of space-time earthquake occurrences. *Journal of the American Statistical Association,* 97(458), 369-380.

Figures 4A-D. Conceptual Model for Gang Violent Crimes in Time and Patterns of Retailation



Note: Figure A. A sequence of gang violent crimes arrayed in time. B. The gang violent crimes from series A that were reported to the LAPD, but were not reported to by GRYD IR. C. The gang crimes from A that were both reported to the LAPD and reported to by GRYD IR. Causal pathways in timelines B and C are given by lower case letters a', a, b' and b. Events labeled as s are spontaneous background events that cannot be causally linked to some prior event. The expectation is that GRYD IR interventions will be able to impact gang crime via pathways a' and b'. D. A cross-tabulation is also shown linking triggering events to retaliation events.

Regardless of how events were labeled, as LAPD-only or LAPD + GRYD IR, there will always be some events that are appear to be spontaneous background events. Spontaneity here means that a crime was not caused by any observed previous event. Clearly, every crime had some cause such as an argument or satisfying some instrumental goal (e.g., eliminating a competitor). However, these causal events are "hidden" from the point of view of the record of previous crimes. Background non-retaliatory crimes are labeled with an **s** in each time line (Figure 4A).

Retaliatory crimes can arise in two different ways that are important for understanding the potential impact of GRYD IR. Figure 4B illustrates causal pathways for retaliatory gang crimes that are ultimately reported to both the LAPD and GRYD IR. Such LAPD + GRYD IR retaliations can be caused by previous gang crimes known only to the LAPD. This pathway is labeled **a** in Figure 4B. Alternatively, LAPD + GRYD IR retaliations can be caused by previous gang crimes known both to LAPD and to GRYD IR. This pathway is labeled **a'** in Figure 4B.

Figure 4C shows causal pathways for retaliatory gang crimes that ultimately are reported only to the LAPD. For one reason or another such events did not come to the attention of GRYD IR. Such LAPD-only retaliations can be caused by previous gang crimes that are also known only to the LAPD. This causal pathway is labeled **b** in Figure 4C. Alternatively, LAPD-only retaliations can be caused by previous gang crimes known to both the LAPD and GRYD IR. This causal pathway is labeled **b'** in Figure 4C.

Importantly, even though Figures 4A-D sketch out a conceptual model of singular events causing other singular events, the statistical estimation procedure used yields average measures.[19] Thus, in the analyses that follow, **a'** is the *average number* of retaliations on the LAPD + GRYD IR timeline triggered by any one LAPD + GRYD IR gang crime, **a** is the *average number* of retaliations on the LAPD + GRYD IR timeline triggered by any one LAPD-only gang crime, and so on. Results will be presented in a cross-tab form showing the average number of retaliations of an outcome type triggered by different source event types (Figure 4D).

Study Hypotheses

The model presented above leads to two explicit hypotheses about the impact of GRYD IR on gang retaliatory violence (Table 6). If GRYD IR reduces the likelihood of gang retaliation, then it is expected that

[19] Lewis, E., & Mohler, G. (2011). A nonparametric EM algorithm for multiscale Hawkes processes. Preprint: 1-16.

the average number of retaliations following LAPD + GRYD IR gang crimes will be less than the average number of retaliations following LAPD-only gang crimes (H1, $\mathbf{a' \leq a}$). The core distinction is that GRYD IR can have a direct impact on the probability of retaliation only following events that it knows about. GRYD IR cannot have a direct impact on retaliation stemming from events that it does not know about[20]. Similarly, the average number of LAPD-only retaliations should be lower if the trigger was a prior LAPD + GRYD IR gang crime than if it was an LAPD-only gang crime (H1, $\mathbf{b' \leq b}$). Notifications about a crime are expected to create opportunities to reduce the likelihood of retaliation, even if GRYD IR is unaware of many follow-on events.

Table 6. Hypothesized Causal Patterns for Retaliatory Crimes

H1	LAPD + GRYD IR gang crimes trigger fewer LAPD + GRYD gang retaliations than do LAPD-only gang crimes.	$a' \leq a$
H2	LAPD + GRYD IR gang crimes trigger fewer LAPD-only gang retaliations than do LAPD-only gang crimes.	$b' \leq b$

Key Terminology

A number of specific terms are used throughout this report to refer to different collections of data and causal relationships. These terms are defined here for quick reference:

- **Violent Crime** – any aggravated assault (equivalently, assault with a deadly weapon), criminal homicide, attempted or completed robbery, shots fired and shots fired at a dwelling. The term includes both gang and non-gang violent crimes.
- **Gang Crime** – any violent crime flagged by LAPD *or* GRYD as associated with gang activity.
- **Non-Gang Crime** – any violent crime not flagged as a gang crime by LAPD *and* GRYD.
- **LAPD + GRYD IR Crime** – any violent crime brought to the attention of the GRYD Office and therefore a possible target of intervention.
- **LAPD + GRYD IR Gang Crime** – any gang-related crime brought to the attention of GRYD IR and therefore is a possible target of intervention.
- **LAPD-Only Crime** – any violent crime reported to the LAPD, but not brought to the attention of GRYD IR and therefore is not a possible target of intervention.
- **LAPD-Only Gang Crime** – any violent gang crime reported to the LAPD, but not brought to the attention of GRYD IR and therefore is not a possible target of intervention.
- **Background Crime or Background Gang Crime** – a crime that occurs spontaneously and cannot be statistically linked to any previous crime.
- **Triggering Crime or Triggering Gang Crime** – a crime that can be statistically described as the cause of one or more subsequent crimes.
- **Retaliation** – A crime that can be statistically described as having been caused by a previous crime.

Description of Data and Methods

The analysis in this section relies on data entered into the GRYD Efforts and Outcomes (ETO) Intervention Incident Response database (see "An Overview of GRYD Intervention Incident Response" section for a

[20] GRYD IR may have indirect effects that arise from activities in the community that are not a direct response to flagged crimes. These higher order effects are not discussed explicitly here, but they are an integral part of the statistical model structure.

description of this data source) matched with data from the Los Angeles Police Department (LAPD). Data provided by the LAPD include only officially reported crimes that have been through the Department's standard process of verification and quality control. Neither calls for service data, nor suspect and arrest data were used. Crime reports cover the following pieces of information:

- Official Record Number
- Type of Crime
- Date and Time of Crime
- Crime Location (Address)
- Crime Location (Latitude and Longitude)
- A Flag Indicating if the Event is a Gang Crime According to the LAPD.

The LAPD data includes records for all reported crime types ranging from public disorder to homicide. Most of these crime types are not directly relevant to understanding the dynamics of gang violence and the impact of GRYD IR. Therefore, attention was restricted to the types of violent crimes flagged by LAPD as gang crimes as well as those where weapons were frequently involved. The crime types targeted in this evaluation are listed below, however, core statistical analyses focus on gang criminal homicide and gang aggravated assault.

- Criminal Homicide
- Aggravated Assault (Assault with a Deadly Weapon)
- Robbery and Attempted Robbery
- Discharge of a Weapon/Shots Fired and Shots Fired at a Dwelling

Although violent crime and violent gang crime in Los Angeles between 2008-2015 was examined in this study to assess temporal trends, the detailed statistical analyses included in this chapter focus on the period from January 1, 2014 to December 31, 2015. During this time, there were 37,003 recorded violent crime incidents in Los Angeles. Of these, 6,646 were flagged as gang crimes by the LAPD. Over the same time period, 1,587 notifications were made to GRYD IR. Of these events, the GRYD Office flagged 432 crimes as not gang related, 426 as unknown, and 729 as gang crimes on the basis of initial information.

Matching GRYD IR Events to LAPD Crime Records

Matches were sought for all GRYD IR crimes recorded in the ETO database with LAPD violent crime records for all of 2014 and 2015. Several lines of evidence were used to match events including similarity in the date and time of the event, the location of the crime, the specific crime type location, crime type and, where possible, a description of the incident itself.[21] Of the 1,587 GRYD IR notifications received throughout 2014 and 2015, a total of 1,536 were successfully matched to LAPD reported crimes (Table 7). Unmatched events include those that occurred outside of the City of Los Angeles, though GRYD still received notification about them. Only a handful of events appear to have occurred inside Los Angeles but cannot be aligned with an LAPD recorded crime. The vast majority of homicides, single victim shootings and multiple victim shootings were successfully matched with LAPD reported crimes.

[21] LAPD crime records frequently included a short narrative description of the crime which could be compared with text accompanying the original reporting of the event to GRYD.

Table 7. GRYD IR Events Successfully and Unsuccessfully Matched with LAPD Reported Crimes

	Matched		Unmatched		Total
	N	%	N	%	N
Homicide	375	97.7	9	2.3	384
Multiple Victim Shooting	143	98.6	2	1.4	145
Single Victim Shooting	989	96.6	35	3.4	1,024
Stabbing	6	85.7	1	14.3	7
Shots Fired	12	92.3	1	7.7	13
Other	8	80.0	2	20.0	10
N/A or Unknown	3	75.0	1	25.0	4
Total	**1,536**	**96.8**	**51**	**3.2**	**1,587**

Although there was a high rate of matches between GRYD IR and LAPD data, it should be noted that violent crimes known to GRYD IR are but a small subset of those known to the LAPD. Table 8 show the number of violent crimes where GRYD IR was notified alongside those events and where there is no record of GRYD notification. With the exception of criminal homicide, all other violent crime types were reported to GRYD IR at a rate of 5.9% or less. More criminal homicides were reported to GRYD IR (67.0%) than not (33.0%). Designation of a crime as a gang crime dramatically increased the rate at which it is reported to GRYD IR. Gang aggravated assaults (assault with deadly weapon) were reported to GRYD IR at a rate of 20.9% (Table 9). Nearly 80.0% of all criminal homicides were reported to GRYD IR if they were deemed to be gang related (Table 9).

Table 8. Number of Violent Crimes where GRYD was Notified and Not Notified in 2014-2015*

	GRYD Notification		No Notification		Total
	N	%	N	%	N
Aggravated Assaults	1,077	5.9	17,228	94.1	18,305
Attempted Robbery	15	0.7	2,113	99.3	2,128
Criminal Homicide	364	67.0	179	33.0	543
Shots Fired	7	0.9	742	99.1	749
Robbery	36	0.2	14,757	99.8	14,793
Shots Fired at Dwelling	7	1.4	478	98.6	485
Total**	**1,506**	**4.1**	**35,497**	**95.9**	**37,003**

*Notes: *Does not distinguish between gang and non-gang crimes; **Includes only those GRYD IR events successfully matched to LAPD crime records.*

Table 8 and 9 provide some context for qualitatively characterizing the potential impact of GRYD IR. With the exception of criminal homicides, Table 9 suggests that GRYD IR has the opportunity to directly impact

only a small fraction of all the violent crime that is occurring in Los Angeles. Notification on 5.9% of generic aggravated assaults leaves around 94.1% of such crimes without any avenue for direct impact. GRYD IR had a much greater potential to impact generic criminal homicides and the retaliations that might follow, regardless of whether they were formally labeled as gang crimes. When considering gang crimes only, there was a greater potential for impact both with aggravated assaults and criminal homicides. Approximately 80.0% of gang aggravated assaults remain where it would have been unlikely to see direct effects of GRYD IR interventions. The implication is that GRYD IR operates against a much larger background of crimes. The effect of GRYD IR was necessarily diluted at an aggregate scale. It would be expected to observe an impact of GRYD IR at a much finer scale of individual events.

Table 9. Number of Gang Violent Crimes where GRYD was Notified and Not Notified in 2014-2015*

	GRYD Notification		No Notification		Total
	N	%	N	%	N
Aggravated Assaults	796	20.9	3,009	79.1	3,805
Attempted Robbery	7	2.4	287	97.6	294
Criminal Homicide	256	78.8	69	21.2	325
Shots Fired	2	1.4	142	98.6	144
Robbery	12	0.6	1,892	99.4	1,904
Shots Fired at Dwelling	5	2.9	169	97.1	174
Total**	**1,078**	**16.2**	**5,568**	**83.8**	**6,646**

*Notes: * Includes only gang crimes; **Includes only those GRYD IR events successfully matched to LAPD crime records.*

General Crime Trends Impact Measurement of GRYD IR Impacts

The expected impact of GRYD IR also has to be understood against the backdrop of general crime trends. Total volume of violent crime in Los Angeles continued a long-term downward trend in 2012 and 2013 (Table 10). Subsequently, year-on-year increases in violent crime occurred in 2014 and 2015. Similar increases were observed in 2016. Importantly, gang violent crime has remained relatively constant at about 20% of all violent crime in spite of this trend reversal. Therefore, even if GRYD IR has a substantial impact on gang violent crime, we may still expect to see an overall increase in gang violent crime at the aggregate level. The trend reversal in overall violent crime is driven by large-scale social and economic processes beyond the control of GRYD IR. This provides further incentive to seek to measure the impact of GRYD IR at the scale of the events rather than aggregate crime statistics.

Table 10. Numbers of Gang and Non-gang Violent Crimes Occurring in Los Angeles between 2012 and 2015

Year	Total	Gang		Non-Gang	
	N	N	%	N	%
2012	17,443	3,580	20.5	13,863	79.5
2013	15,679	2,979	19.0	12,700	81.0
2014	17,127	3,033	17.7	14,094	82.3
2015	19,876	3,613	18.2	16,263	81.8
Total	**70,125**	**13,205**	**18.8**	**56,920**	**81.2**

The Challenge of Defining Gang Crime

The matching process also revealed discrepancies in defining gang crime. The California Penal Code (CPC § 186.22) provides guidelines for attaching a gang enhancement to any crime. The central premise is that any crime that is committed for the benefit of a gang is eligible to be labeled as a gang crime, and individuals convicted of committing such crimes are subject to enhanced sentences. How a gang label is applied in practice by police (and prosecutors) to individual crimes is not specified by the criminal code. In general, whether or not something is labeled as a gang crime very much depends upon the particular circumstances of the crime. In principal, any type of crime can potentially be committed for the benefit of a gang.

Using Los Angeles Police Department (LAPD) crime data for 2014-2015, 90 different crime types bear a gang crime label. Table 11 shows the top 15 of these crime types sorted in descending order by the percentage that bear a gang label. Gang homicides make up 59.9% of all homicides in Los Angeles in 2014 and 2015. Gang aggravated assault (assault with a deadly weapon) represents a greater number of events by volume (n =3,805), but constitute only 20.8% of all aggravated assaults recorded during this time frame.

The data in Table 11 raise concerns that the application of a gang label is overly broad for the purpose of evaluating the impact of interventions designed to curb gang violence in this evaluation. For example, it is questionable whether the 171 burglaries labeled as gang crimes in 2014-2015 (0.6% of all burglaries) have much to do with gang rivalries and the risk of retaliatory gang violence, even though the suspects or victims in such crimes may have been gang-involved.

Table 11. Top 15 Gang Crime Types by Volume in 2014-2015 for All LAPD Data

Rank †	Crime Type	Gang		Non Gang		Total
		N	%	N	%	N
1	Criminal Homicide	325	59.9	218	40.1	543
2	Shots Fired at Inhabited Dwelling	174	35.9	311	64.1	485
3	Aggravated Assault	3,805	20.8	14,500	79.2	18,305
4	Discharge Firearms/Shots Fired	144	19.2	605	80.8	749
5	Attempted Robbery	294	13.8	1,834	86.2	2,128
6	Robbery	1,904	12.9	12,889	87.1	14,793
7	Violation of Court Order	419	11.1	3,355	88.9	3,774
8	Brandish Weapon	177	9.6	1,659	90.4	1,836
9	Criminal Threats - No Weapon Displayed	912	8.0	10,551	92.0	11,463
10	Other Miscellaneous Crime	171	4.5	3,591	95.5	3,762
11	Vandalism - Felony	639	3.0	20,586	97.0	21,225
12	Vandalism - Misdemeanor	307	1.7	17,261	98.3	17,568
13	Battery - Simple Assault	538	1.5	35,550	98.5	36,088
14	Spousal Abuse - Simple Assault	270	1.1	24,115	98.9	24,385
15	Burglary	171	0.6	28,526	99.4	28,697

Note: † crime types are ranked by percentage gang related.

The subsequent analyses focus only on violent crimes with ecologically reasonable connections to gang activity. These include criminal homicide, shots fired at an inhabited dwelling, aggravated assault (assault with a deadly weapon), shots fired, attempted robbery and robbery. At least 10% of all recorded crimes of these types are labeled as gang crimes. Criminal threats (without a weapon) and brandishing a weapon, though showing some connections to gang activity, are excluded as the nature of reporting biases for these crimes are poorly understood. Resisting arrest, battery on police, and assault with a deadly weapon on police, also show a connection to gangs—ranked 21, 24 and 25 by volume of gang crimes. These are excluded because such events are related more to the interaction between police and gangs than the interactions between gangs themselves.

To address this issue in some measure, the GRYD Office implemented context-based definition of gang crime in May 2015. Five different characteristics are flagged by GRYD Regional Program Coordinators (GRYD RPCs) including information on whether the event: (1) was gang motivated; (2) occurred in a gang area; (3) featured gang involved or affiliated individuals; (4) recent activity occurred between the victim's or suspect's affiliated gangs, or (5) has the potential for retaliation. These are treated as independent variables that can be summed to reflect the degree to which an event is gang related (Table 12). This new measure shows that events fall on a graduated continuum between non-gang and gang crime. Events with none of these characteristics are unlikely to be recognized as gang crimes. Events that include all of these characteristics almost certainly will be classified as gang crimes. Events with an intermediate mixture (1-3) of these characteristics are more likely to be classified as unknown. It requires 4 or more of these characteristics to be more likely to be classified as gang crime than not.

Table 12. Gang Event Characteristics and the Classification of Gang Crimes

Sum of Gang Characteristics	GRYD Gang Classification			Total
	No	Unknown	Yes (potential for retaliation)	N
0	43	20	0	63
1	41	65	11	117
2	14	74	23	111
3	2	58	41	101
4	0	30	80	110
5	0	1	14	15
Total	**100**	**248**	**169**	**517**

Note: Collection of data on gang characteristics for each IR event started on May 25, 2015.

Description of Analyses

To begin, these data indicated substantial differences between 2008-2013, when crime overall was declining, and 2014-2015, when crime was increasing.

The spatial nature of retaliation was examined in some detail. To understand such spatial processes, it is preferable to identify a large area over which GRYD IR was in operation without intervening gaps in coverage. The South Los Angeles GRYD Zones provide the best example of such continuous coverage (Figure 5). As of mid-2015, the ten GRYD Zones South of the 10 Freeway form a contiguous area of attention. Prior to mid-2015, only seven of the ten regions shown in Figure 5 were recognized as GRYD Zones in some form. In spite of the addition of the three new GRYD Zones only in mid-2015, GRYD IR was receiving notifications over this entire area throughout 2014 and 2015. For example, between July 1, 2014 and December 31, 2014, GRYD IR was notified of 109 events over the South Los Angeles region (Figure 6). Between July 1, 2015 and December 31, 2015, GRYD IR was notified of 129 events over this region, only an 18% increase in notifications. The one possible exception is in the area covered by the 77th 3 GRYD Zone, which was added only in mid-2015. Few notifications were received for this geographic area prior to the formal addition of the 77th 3 GRYD Zone. In all other locations, GRYD IR crimes were recorded regardless of whether there was a formal GRYD Zone in place or not.

Therefore, the South Los Angeles GRYD Zones were treated as a single continuous study region for 2014 and 2015. This region is well bounded, but still expansive enough to understand the spatial dynamics of gang retaliatory violence. During this period, there were 12,905 violent crimes reported to the LAPD in the South Los Angeles GRYD Zones. Of these, 3,054 were flagged as gang related. GRYD IR was notified about 809 of these violent crimes, with 666 of the notifications flagged as gang related. These models were tested using spatio-temporal multivariate Hawkes process statistical models (see Appendix).

Figure 5. Map of South Los Angeles Showing the Ten Contiguous GRYD Zones in Operation as of Mid-2015

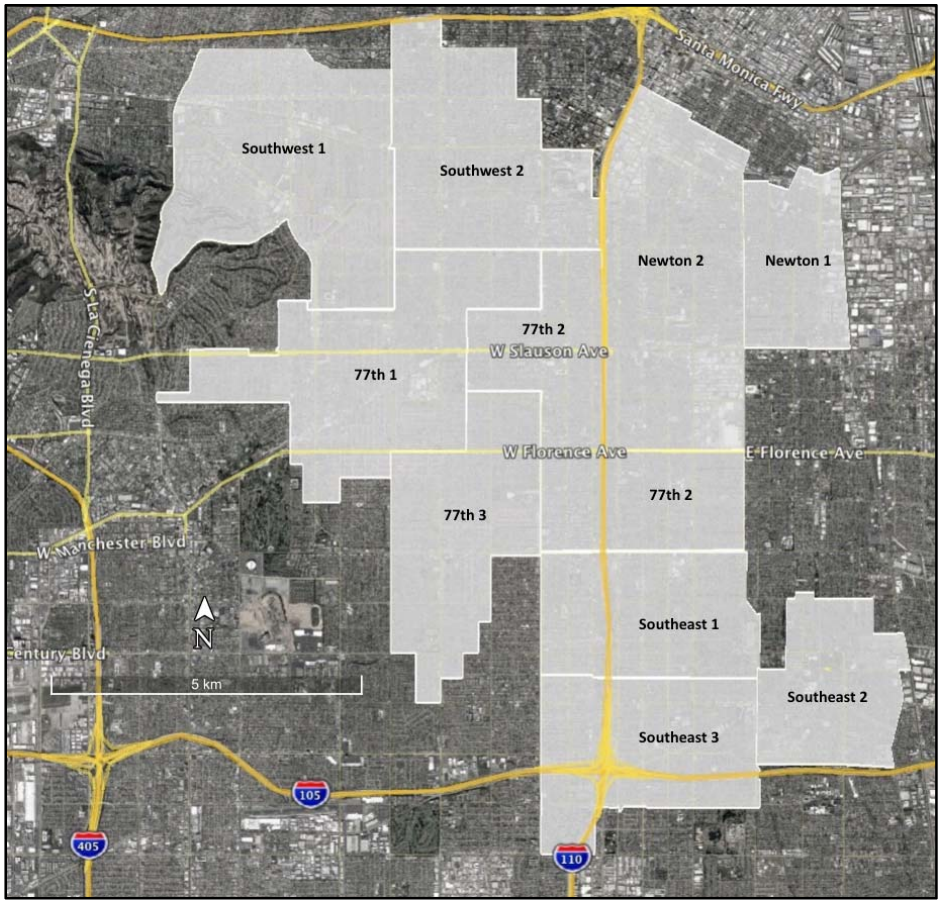
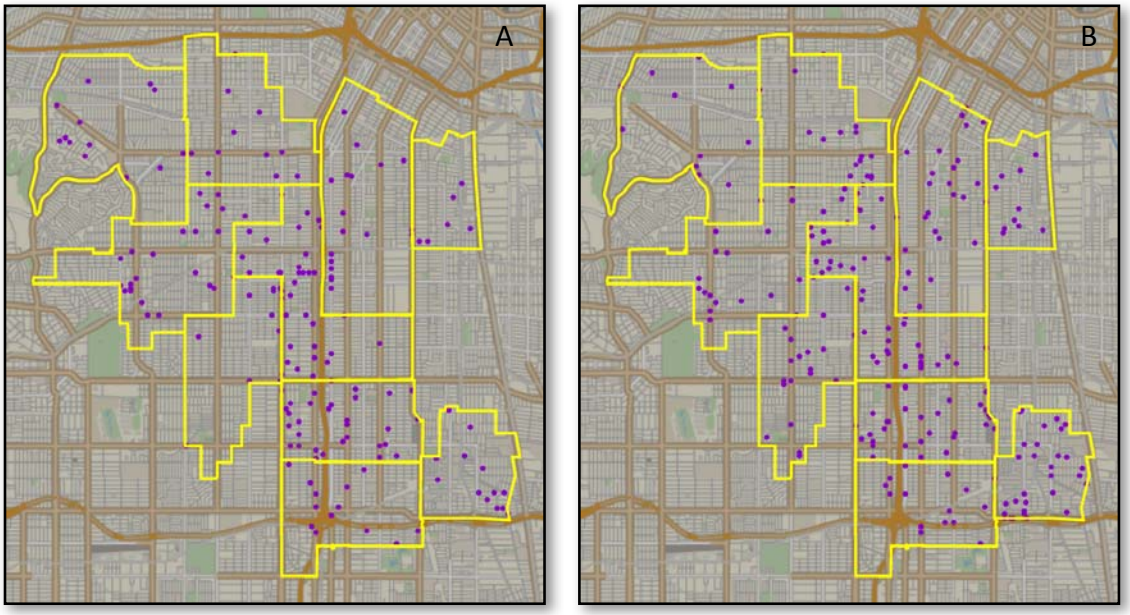


Figure 6. Locations of GRYD IR Violent Crimes (purple) in a Comparable Six Month Period before (A) and after (B) the July 2015 Expansion of GRYD Zones in South Los Angeles – Time Periods Cover July-December 2014 (A) and July-December 2015 (B)



Results

As mentioned, this evaluation investigated the potential impact of the program based on the incidents that were notified by GRYD IR compared to incidents that the Los Angeles Police Department (LAPD) is notified of. This section begins with an examination of measured impact by GRYD IR on the likelihood of gang retaliation followed by an analysis of GRYD IR in South Los Angeles. The following two hypotheses were tested:

- **H1.** LAPD + GRYD IR gang crimes trigger fewer LAPD + GRYD IR gang crime retaliations than do LAPD-only gang crimes (i.e., **a'** ≤ **a**).
- **H2.** LAPD + GRYD IR gang crimes trigger fewer LAPD-only gang crime retaliations than do LAPD-only gang crimes (i.e., **b'** ≤ **b**).

Restricting analyses to gang homicides and aggravated assaults occurring in space and time[22] shows that GRYD interventions have a substantial impact on reducing retaliation (Table 13). As initially hypothesized, LAPD + GRYD IR gang crimes triggered substantially fewer LAPD + GRYD IR gang retaliations than did LAPD-only gang crimes (i.e., a' < a, or 0.0018 < 0.0475). This represents a 96.2% reduction in retaliation associated with GRYD IR notification. The reduction is statistically significant at $p < 0.0001$. Every 100 LAPD + GRYD IR gang crimes triggered fewer than 0.2 additional LAPD + GRYD IR retaliations. By contrast, every 100 LAPD-only gang crimes generated 4.8 LAPD + GRYD IR gang retaliations. The fundamental difference between LAPD + GRYD IR and LAPD-only trigger events is the notification of GRYD IR and the potential for follow-on intervention effects.

LAPD + GRYD IR also triggered fewer LAPD-only gang retaliations than LAPD-only gang trigger crimes (i.e., b' < b, 0.1346 < 0.1928). Every 100 LAPD + GRYD IR gang crimes is expected to trigger an additional 13.5 LAPD gang retaliations. Every 100 LAPD gang crimes is expected to generate 19.3 additional LAPD gang retaliations. The 30.2% reduction in retaliations is statistically significant at $p < 0.05$. Taken together, both hypotheses regarding GRYD IR effectiveness were supported.

Table 13. Average Number of Gang Retaliations Triggered by GRYD IR Gang Crimes and by LAPD Gang Crimes City Wide

	LAPD + GRYD IR gang retaliation	LAPD-only gang retaliation
LAPD + GRYD IR gang trigger	0.0018***	0.1346*
LAPD-only gang trigger	0.0475	0.1928

*Note: ** statistical significant difference (a' < a) at p < 0.0001; * statistical significant difference (b' < b) at p < 0.05.*

The combined number of retaliations triggered on average by any one LAPD + GRYD IR crime is the sum of retaliations reported to LAPD and GRYD IR and those reported only to LAPD (i.e., **a'** + **b'** = 0.1364). Similarly, the combined average number of retaliations triggered by LAPD-only gang crimes is the sum of retaliations reported to LAPD and GRYD and LAPD only (i.e., **a** + **b** = 0.2403). Total average retaliations are 43.2% lower when GRYD IR was notified compared with when they were not.

These are all the more remarkable because GRYD IR starts from a less advantageous position given the mix of crimes about which GRYD IR received notification. The same analyses were run for violent crime,

[22] Here only the temporal model was considered. The full spatio-temporal model was considered below in a detailed analysis of the South LA GRYD Zones.

ignoring whether they were gang crimes, shows that LAPD + GRYD IR triggered many more LAPD + GRYD IR retaliations than do LAPD-only trigger events (i.e., **a'** > **a**). LAPD + GRYD-IR violent also triggered many more LAPD-only violent retaliations than do LAPD-only trigger events (i.e., **b'** > **b**). The reversal of effect was driven by the fact that the set of LAPD + GRYD IR violent crimes included a much greater proportion of gang violent crimes, which presumably entailed a greater likelihood of retaliation overall for the crimes confronted by GRYD IR. The LAPD-only set harbored a mix of events and, critically, many more non-gang crimes where retaliation was much less likely. Restricting analyses to gang aggravated assaults and gang homicides leveled the playing field to some degree, but not completely. Indeed, Table 13 presented above shows that GRYD IR was still much more likely to be notified of a gang homicide than any other crime type.

Analysis of Gang Crime and GRYD IR in South Los Angles GRYD Zones

South Los Angeles is a major focus of GRYD IR. Nearly half of all GRYD Zones citywide are located in South Los Angeles and, as of mid-2015, these form a contiguous area focused on intervention incident response. Between January 1, 2014 and December 31, 2014, a total of 12,905 violent crimes were reported to the LAPD in the South Los Angeles GRYD Zones (Table 14). On average, 23.7% of these events were flagged as gang related. However, the magnitude of gang involvement varied considerably by crime type. Fully 77.1% of criminal homicides in the South Los Angeles GRYD Zones were classified as being connected to gangs. Nearly 30% of aggravated assaults were similarly classified. Only for 809 of the total reported crimes did GRYD IR receive notification (Table 15). But of those, more than 82% were labeled as gang crimes. Notifications received about criminal homicides and aggravated assaults were flagged as gang crimes 85.3% and 82.8% of the time, respectively. In the South Los Angeles GRYD Zones, as in the city as a whole, GRYD IR was preferentially notified about the most serious of crimes.

Table 14. Frequency of All Gang and Non-gang Violent Crimes in the South Los Angeles GRYD Zones in 2014-2105*

	Gang		Non-Gang		Total
	N	%	N	%	N
Criminal Homicide	199	77.1	59	22.9	258
Shots Fired at Inhabited Dwelling	94	39.2	146	60.8	240
Assault With Deadly Weapon	1,819	29.6	4,316	70.4	6,135
Shots Fired	57	20.1	227	79.9	284
Robbery	801	15.1	4,517	84.9	5,318
Attempted Robbery	84	12.5	586	87.5	670
Total	**3,054**	**23.7**	**9,851**	**76.3**	**12,905**

*Notes: * Sorted by percent gang related.*

Table 15. Frequency of All Gang and Non-gang Crimes in the South Los Angeles GRYD Zones for which GRYD IR Received Notification in 2014-2015*

	Gang		Non-Gang		Total
	N	%	N	%	N
Criminal Homicide	157	85.3	27	14.7	184
Assault With Deadly Weapon	496	82.8	103	17.2	599
Robbery	10	58.8	7	41.2	17
Attempted Robbery	2	33.3	4	66.7	6
Shots Fired	0	0.0	2	100.0	2
Shots Fired at Inhabited Dwelling	1	100.0	0	0.0	1
Total	**666**	**82.3**	**143**	**17.7**	**809**

*Notes: *Sorted by percent gang related with exception of shots fired at inhabited dwelling.*

The hypotheses tested above were also tested in this more restricted area. This led to an ability to examine in some detail how retaliation occurred in both space and time. The statistical definition of retaliation using only temporal information holds that a crime is classified as retaliatory if it is in some way caused by one or more prior events. Extending this definition to also consider the effects of space that a crime is retaliatory if it is in some way caused by one or more prior events that occurred nearby. Intuitively, two homicides on the same street block are more likely to be linked by retaliation than two homicides that occurred on opposite sides of the city.

Table 16 reinforces the conclusion that GRYD IR has a significant impact on gang retaliations. LAPD + GRYD IR gang crimes triggered many fewer LAPD + GRYD IR gang retaliations (i.e., **a'** < **a**, or 0.0015 < 0.0621). For every 100 GRYD IR gang crimes there were fewer than 0.2 retaliations. For every 100 LAPD-only gang crimes there were 6.2 gang retaliations. This represents an 97.5% lower likelihood of retaliation when GRYD IR was involved related to the non-intervention control. The difference is statistically significant at $p < 0.0001$.

LAPD + GRYD IR gang crimes triggered fewer LAPD-only gang crimes compared with LAPD-only triggers (i.e., **b'** < **b**, or 0.1483 < 0.2116). Every 100 LAPD + GRYD IR gang crimes triggered an additional 14.8 LAPD-only retaliations on average. Every 100 LAPD-only gang crime triggered 21.2 LAPD-only gang retaliations on average. This represents a 29.9% lower likelihood of retaliation when GRYD IR was involved related to the non-intervention control. The difference is statistically significant at $p < 0.05$.

Table 16. Average Number of Gang Retaliations Triggered by GRYD IR Gang Crimes and by LAPD Gang Crimes in the South Los Angeles GRYD Zones

	LAPD + GRYD IR retaliation	LAPD-only retaliation
LAPD + GRYD IR Trigger	0.0015**	0.1483*
LAPD-only Trigger	0.0621	0.2116

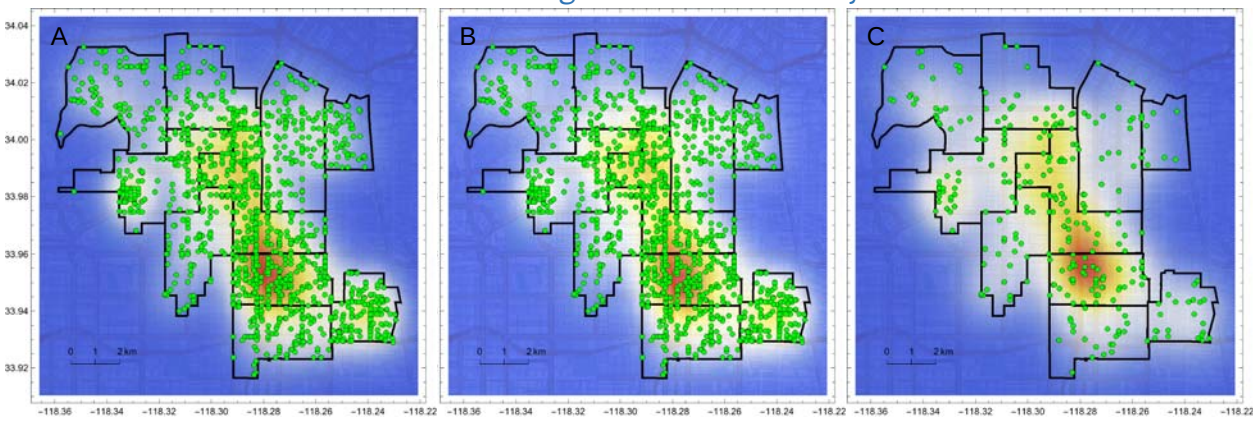
*Note: ** statistical significant difference (a' < a) at p < 0.0001; * statistical significant difference (b' < b) at p < 0.05.*

The combined number of retaliations triggered on average by any one LAPD + GRYD IR crime is the sum of retaliations reported to LAPD and GRYD and those events that are only reported to LAPD (i.e., **a'** + **b'** = 0.1498). Similarly, the combined average number of retaliations triggered by LAPD-only gang crimes is the sum of retaliations reported to LAPD and GRYD and LAPD only (i.e., **a** + **b** = 0.2737). Total average retaliations in the South Los Angeles GRYD Zones were 45.3% lower when GRYD IR was notified compared with when they were not.

Retaliation is Concentrated in Space

It is not expected that the impact of GRYD IR will be uniformly distributed across space. Rather, the chance of retaliation likely varies across neighborhoods, while the efficacy of different intervention agencies may also vary. Figures 7A-C shows the distribution of non-retaliatory background and retaliatory gang crimes in South Los Angeles. The density of retaliations follows the overall density of violent gang crime (Figure A) and background events (Figure B). In general, more gang crime means more retaliation. In the case of South Los Angeles, an epicenter of retaliation straddling the Southeast 1 and 77th 2 GRYD Zones stands out as a primary location of concern (Figure C).

Figures 7A-C. Stotastic declustering of gang homicides and aggravatged assaults showing the location of background and retaliatory crimes.



Note: (A) All gang aggravated assaults and homicides in South Los Angeles GRYD Zones. (B) background gang aggravated assaults and homicides. (C) retaliation gang aggravated assaults and homicides. South Los Angeles GYRD Zones are shown highlighted in black. Heat maps are a standard kernel density estimation based on the location of crimes shown in green.

Retaliation by Crime Type

Different crime types vary in the likelihood that they are themselves retaliatory.[23] Methods that classify each gang crime occurring in the South Los Angeles GRYD Zones as either non-retaliatory background crimes or retaliatory crimes were used.[24] For the combined LAPD and GRYD IR data in South Los Angeles, there were 1,912 gang aggravated assaults and criminal homicides in total, of which 30.6% were retaliatory crimes (Table 17). Examining retaliation by crime type shows that aggravated assaults (assault with a deadly weapon), including both single and multiple victim shootings, were more likely to be retaliations than criminal homicides. Approximately one-third of all gang aggravated assaults were retaliatory. Retaliatory criminal homicides on average made up only 5% of gang homicides.

[23] Note that whether events themselves are background or retaliatory was analyzed here, not whether an event triggers a retaliation. The difference is important in that a background or retaliatory event could each trigger a future retaliation, whereas under most circumstances it would be said that a background event cannot also be a retaliation and vice versa.
[24] Zhuang, J., Ogata, Y., & Vere-Jones, D. (2002). Stochastic declustering of space-time earthquake occurrences. *Journal of the American Statistical Association,* 97(458), 369-380.

Table 17. Background and Retaliation Events by Crime Type for Combined LAPD-only and LAPD + GRYD IR Gang Crimes in South Los Angeles GRYD Zones During 2014-2015*

	Background	Retaliation	Total	% Retaliation
Aggravated Assault	1,280	439	1,719	34.3
Criminal Homicide	184	9	193	4.9
Total	**1,464**	**448**	**1,912**	**30.6**

*Notes: * Table is sorted in descending order by % retaliation.*

Table 18 and Table 19 respectively, look at those crimes known only to the LAPD and those known to both LAPD and GRYD IR. Retaliatory aggravated assaults were four-times more common for LAPD-only events compared to LAPD + GRYD events (46.3% vs. 10.3%). LAPD-only criminal homicides were thirty-six times more common than LAPD + GRYD IR retaliatory homicides (24.2% vs. 0.7%). The evidence suggests that GRYD IR had a significant additive effect on reducing retaliation for serious assaults and criminal homicides.

Table 18. Background and Retaliation Events by Crime Type for LAPD-only Gang Crimes in South Los Angeles GRYD Zones During 2014-2015*

	Background	Retaliation	Total	% Retaliation
Aggravated Assault	854	395	1,249	46.3
Criminal Homicide	33	8	41	24.2
Total	**887**	**403**	**1,290**	**45.4**

*Notes: * Table is sorted in descending order by % retaliation.*

Table 19. Background and Retaliation Events by Crime Type for LAPD + GRYD IR Gang Crimes in South Los Angeles GRYD Zones During 2014-2015*

	Background	Retaliation	Total	% Retaliation
Aggravated Assault	426	44	470	10.3
Criminal Homicide	151	1	152	0.7
Total	**577**	**45**	**622**	**7.8**

*Notes: * Table is sorted in descending order by % retaliation.*

Prevented Retaliations and the Cost of Gang Crime

The classification of events as either background or retaliatory crimes provides an opportunity to estimate the number of prevented crimes (see Appendix). It was assumed that the rate of retaliation in the absence of GRYD IR would have been the same as for LAPD-only estimated from the observed data. In South Los Angeles, GRYD IR prevented an estimated 82.2 gang violent crimes over 2014-2015, compared to the LAPD-only controls. This included an estimated 4.4 fewer gang homicides and 77.8 fewer gang aggravated

assaults, primarily single and multi-victim shootings. Computed city-wide, GRYD IR prevented an estimated 185.1 gang violent crimes in 2014-2015 compared the LAPD-only controls. This includes 9.9 gang homicides and 175.2 gang aggravated assaults.

Recent estimates seeking to quantify the procedural, physical and emotional costs of crime find that a single homicide costs the criminal justice system, the victim's family and society-at-large $8.98 million[25]. A single aggravated assault costs an estimated $240,000.

In South Los Angeles, the combined benefit of GRYD IR prevention of gang violent crime retaliation is substantial. The estimated number of homicides prevented by GRYD IR may add up to savings between $39.4 million over two years. The savings from prevented gang aggravated assaults in South Los Angeles may amount to an additional $9.5 million over two years. The combined savings per year in South Los Angeles alone may amount to $49.0 million.

For the City of Los Angeles as a whole, the estimated number of homicides prevented by GRYD IR may add up to savings of $88.8 million over two years. The estimated savings from the prevented aggravated assaults may total $21.3 million. The total estimated savings from GRYD IR deployments in 2014-2015 may total $110.2 million, or $55.1 per year.

[25] McCollister, K. E., French, M. T., & Fang, H. (2010). The cost of crime to society: New crime-specific estimates for policy and program evaluation. *Drug and Alcohol Dependence*, 108(1), 98-109.

Summary and Conclusion

Taken together, the results of this study provide substantial insight into the potential impact of GRYD Intervention Incident Response (IR) on gang crime. The 2017 report builds on previous reports completed by the Urban Institute and differs substantially from their analytical approaches in previous evaluations. Specifically, this report focuses on a statistical model for retaliatory violence that makes it possible to provide estimates of the average number of retaliations; therefore, GRYD can respond rapidly to try to mitigate the conditions that make retaliation possible. This conceptual framework focuses on short term, local efforts of GRYD IR.

Using matched LAPD and GRYD IR data, this study was able to analyze data from January 1, 2014 through December 31, 2015. Collectively, the findings show that GRYD IR:

1) uses a nuanced, but functional and robust definition of gang crime that reflects the complexity of the problem through the use of a statistical process of gang retaliation at the scale of individual events;
2) documented significant reductions in participation in crime, violence, and gang activities – for example, GRYD IR prevented an estimated 185 gang violent crimes city wide in 2014-2015; and,
3) a reduction in an estimated 10 fewer homicides and 175 fewer aggravated assaults, primarily single and multiple victim shootings.

Summary of Incident Characteristics and Actions Taken

Of the GRYD IR incidents matched to the LAPD reported crimes, approximately half of these incidents enacted the full triangle protocol where both GRYD RPC and CIW provided some type of action. Between the years 2014 and 2015, the number of incidents doubled from 266 to 526 incidents in 2015. The majority of the incidents occurred inside the GRYD Zones.

GRYD IR in 2015 Profile

- **77.9% of incidents responded by GRYD IR in 2015 occurred inside GRYD Zones**
- 66.2% were single victim shooting
- 23.4% were homicides
- 8.6% were multiple victim shootings
- 96.4% of GRYD RPC actions were related to phone call/emails
- 87.6% of CIW actions were related to deploying to the scene, hospital, or community
- 44.5% of CIW contacts within 24 hours were contacts related to the victim's family
- 31.0% of CIW contacts within 24 hours were related to contacts with the victim or perpetrators

Once GRYD IR were notified, GRYD RPCs were more likely to make phone calls and send emails to relay information between partners whereas CIWs were more likely to deploy to the scene, hospital, or community. In the community, CIWs canvassed the community/provided outreach, controlled the diffusion of rumors, and connected victim/victim's family to services.

For incidents to which GRYD resources were applied, a variety of contact took place depending on the incident characteristics. GRYD RPCs were in contact with LAPD within the first 24 hours. Conversely, CIWs were more likely to be in contact with the victim's family, the victim/perpetrator gangs, and LAPD across both years.

Summary of Findings from GRYD IR Expected Impact

Retaliatory gang crimes are most frequently defined based on qualitative evidence such as knowledge about the suspects or victims involved and the history of interactions between individuals or groups. This research

defines a retaliation in statistical terms as any gang crime that can be shown to be causally related to one or more prior gang crimes. Non-retaliatory, background crimes are therefore gang crimes that are statistically independent of any prior event.

A multivariate Hawkes process model is used to estimate the average number of gang where the triggering event is known both by the LAPD and GRYD IR and alternatively only to the LAPD. Estimates are made for two types of outcomes: (1) retaliations that are known both by the LAPD and GRYD IR; and (2) retaliations only reported to the LAPD. On average, for every 100 gang crimes known to GRYD IR there are 0.18 additional gang retaliations that are known to GRYD IR. For every 100 gang crimes known only to the LAPD there are 4.75 gang retaliations known to GRYD IR. GRYD IR produces 96.2% fewer retaliations requiring GRYD response. This reduction in retaliation is significant at $p < 0.0001$. For every 100 gang crimes known to GRYD there are 13.46 gang retaliations known only to the LAPD. For every 100 gang crimes known only to the LAPD, there are 19.28 gang retaliations known only to the LAPD. GRYD IR trigger crimes produce 30.2% fewer retaliations, a statistically significant difference at $p < 0.05$.

Result Highlights

- **GRYD IR prevented an estimated 185 gang violent crimes city wide in 2014-2015.**
- Prevention includes an estimated 10 fewer homicides and 175 fewer aggravated assaults, primary single and multiple victim shootings.
- GRYD IR prevented 82 gang violent crimes in South Los Angeles in 2014-2015.
- Prevention includes 4 fewer homicides and 78 fewer gang aggravated assaults.

Gang crimes entail unique risks of violent retaliation. Cycles of tit-for-tat violence are unfortunately well-known. This report shows that for every 100 gang crime notifications received by GRYD IR there are on average 13.6 violent retaliations. For every 100 gang crimes where GRYD does not receive notification there are on average 24.0 violent retaliations. GRYD IR notifications and subsequent interventions produce 43.2% fewer retaliations compared with the control conditions not involving GRYD. In South Los Angeles, GRYD IR prevented an estimated 82 gang violent crimes over 2014-2015 compared to non-intervention controls. This includes 4 fewer gang homicides and 78 fewer gang aggravated assaults.

Recent estimates seeking to quantify the procedural, physical and emotional costs of crime find that a single homicide costs the criminal justice system, the victim's family and society-at-large $8.98 million[26]. A single aggravated assault costs $240,000. The combined benefit of GRYD IR gang crime prevention citywide is estimated at more than $110.2 million over two years ($55.1 per year).

Today, gang violence is about short-term interactions and their consequences. GRYD IR is designed for this purpose. When notified of incidents, GRYD IR has measurable impact on the number of gang retaliations. Its unique triangle partnership provides a coordinated response to gang crime that is necessary. This impact, not only has its saving benefits in costs of crime, GRYD IR provides an immediate connection and support to communities that may be affected by violence. This report takes a unique first step at examining the significance of local effects of GRYD IR. Further exploration of GRYD IR and its micro level impact will provide insight on how and why GRYD IR works.

[26] McCollister, K. E., French, M. T., & Fang, H. (2010). The cost of crime to society: New crime-specific estimates for policy and program evaluation. *Drug and Alcohol Dependence*, 108(1), 98-109.

Appendix

IR Characteristics and Actions Taken

Table 20. Incidents Across GRYD Zones

	2014 (N=266)		2015 (N=526)	
	N	%	N	%
77th 1**	39	14.7	46	8.7
77th 2	58	21.8	73	13.9
77th 3*	---	---	12	2.3
Devonshire-Topanga*	---	---	4	0.8
Foothill	13	4.9	31	5.9
Harbor	21	7.9	40	7.6
Hollenbeck 1	22	8.3	23	4.4
Hollenbeck 2*	---	---	6	1.1
Hollenbeck 3	8	3.0	16	3.0
Mission	18	6.8	50	9.5
Newton 1**	6	2.3	24	4.6
Newton 2*	---	---	24	4.6
Northeast**	12	4.5	29	5.5
Olympic*	---	---	9	1.7
Pacific	4	1.5	9	1.7
Proyecto Palabra	18	6.8	9	1.7
Rampart 1	13	4.9	19	3.6
Rampart 2	2	0.8	9	1.7
Southeast 1*	---	---	16	3.0
Southeast 2*	---	---	20	3.8
Southeast 3**	3	1.1	13	2.5
Southwest 1	13	4.9	10	1.9
Southwest 2**	16	6.0	34	6.5

* New GRYD Zones starting July 1, 2015
** Change in GRYD provider July 1, 2015

Table 21. Top Three CIW Actions Taken Across GRYD Zones

GRYD Zone	N	Contact Victim's Family	Contact Victim or Prep Groups	Contact LAPD
		%	%	%
77th 1**	46	19.6	82.6	0
77th 2	73	39.7	43.8	17.8
77th 3*	12	66.7	25.0	0
Devonshire-Topanga*	4	50.0	0	50.0
Foothill	31	58.1	16.1	32.3
Harbor	40	35.0	75.0	32.5
Hollenbeck 1	23	91.3	13.0	4.3
Hollenbeck 2*	6	100.0	33.3	16.7
Hollenbeck 3	16	62.5	6.3	6.3
Mission	50	70.0	32.0	48.0
Newton 1**	24	33.3	8.3	25.0
Newton 2*	24	45.8	37.5	33.3
Northeast**	29	37.9	6.9	75.9
Olympic*	9	22.2	22.2	44.4
Pacific	9	55.6	33.3	44.4
Proyecto Palabra	9	55.6	11.1	77.8
Rampart 1	19	36.8	15.8	73.7
Rampart 2	9	44.4	44.4	100.0
Southeast 1*	16	25.0	12.5	25.0
Southeast 2*	20	40.0	5.0	15.0
Southeast 3**	13	23.1	30.8	15.4
Southwest 1	10	10.0	0	40.0
Southwest 2**	34	38.2	0	0

* New GRYD Zones starting July 1, 2015
** Change in GRYD provider July 1, 2015

Defining Retaliation in Statistical Terms

Retaliation is an intuitive concept when viewed at the scale of individuals or gangs. An affront by one party may trigger the desire for retribution through a retaliatory act by the wronged party. Such retaliation may seek to restore the balance in a reciprocal way—eye-for-an-eye justice—or it might seek to add punishment to retribution through escalation. In principal, it is straightforward to identify retaliation in a qualitative sense.

An understanding of the specific interactions and social context of each event should make it obvious if retaliation is involved. Ethnographic methods cannot scale to address the dynamics of retaliation for an entire city, however, with potentially tens of thousands of violent crimes occurring over the course of a year. Study of the patterns and processes in crime at this scale requires a statistical conceptualization of retaliation.

Start with a thought experiment. Imagine two individuals in two adjoining rooms separated by a curtained window. The individuals are each standing at a light switch turning the lights in the room on and off. If the curtain between the two rooms is drawn tight, then intuitively when the light goes on in one room should have no bearing on when it goes on in the other. If you were to watch the two rooms for a while you might find some periods of time during which it would appear that the lights were synchronized, but patterns would be accidental. Over a large enough observational period, the pattern of flipping the switch on and off in one room would be random and independent of the light going on and off in the other room.

Now imagine that the curtains were opened between the rooms. What is going on in one room can now be observed from the other. Under these conditions, it is possible for a relationship to develop between events in the two rooms. Imagine that one individual decides to turn the light on and off at random times. It would not seem at all strange if the individual in the other were to settle on a pattern of behavior where they flip on the light when they see it happen in the other room and flip it off when they see it turned off. In a sense, flipping the light switch in the first room causes the same action to occur in the second. Over a long enough observational period, what happens in one room is causally connected to or dependent upon what happens in the other.

Imagine now looking at a building with thousands of rooms. Some of the rooms are connected by windows with the curtains drawn tight and others with the curtains wide open. However, it is generally not known which rooms fall into each of these two groups. Even without knowing this seemingly critical information the pattern of lights going on and off can be observed and the relationships among all of the rooms measured. If our observations indicate that the lights going on and off in one room have no effect on the lights going on and off in some other room it can be said that these are statistically independent of one another. There is no causal relationship between them. It might be inferred that the curtains were drawn tight. By contrast, if our observations show that the light going on and off in one room leads to the light going on and off in another room then these patterns are not statistically independent. Rather, the on-and-off patterns are causally connected[27]. It might be inferred that the curtains are wide open.

Crime events can be looked at using the exact same conceptual framework. Locations in the urban environment are the equivalent of the thousands of rooms in our building. Crimes occurring in these urban locations are the equivalent of the lights going on-and-off. Even without knowing anything about the physical and social connections between places, or indeed anything about the specific circumstances surrounding the individual crimes, it is possible to observe the spatial and temporal patterns associated with those crimes and infer whether there is any causal connection between them. If the crimes occurring in one location appear random in time with respect to events occurring in the other location, it can safely be said that those events are independent[28]. In statistical terms, crimes in one location do not cause crimes in the other location. Any sample of crimes from an urban environment is going to be made up of many of these independent or random events. Such events can equivalently be referred to as background crimes. By contrast, if the crimes in one location appear to follow the pattern of crimes in another location then those events are not

[27] In a strict sense, the pattern in each room could each be caused by some other third unobserved. In this case, the patterns would be merely correlated but not directly causally related. However, relying on the notion of Granger causality, the true interest is in whether one event provides leverage for predicting a second event regardless of actual mechanisms connecting the events. Given predictive leverage one might use interventions to try and prevent the second event. See: Kim, S., Putrino, D., Ghosh, S., & Brown, E. N. (2011). A granger causality measure for point process models of ensemble neural spiking activity. *Plos Computational Biology*, 7(3).

[28] Short, M. B., D'Orsogna, M. R., Brantingham, P. J., & Tita, G. E. (2009). Measuring and modeling repeat and near-repeat burglary effects. *J. Quant. Criminol.*, 25, 325-339.

independent. In statistical terms, crimes in one location are caused by crimes in the other. When the follow-on crimes are violent it is reasonable to describe them as retaliatory, particularly if gangs are known to be involved.

Spatio-Temporal Multidimensional Point Processes

Self-exciting point process models provide a useful mathematical structure for considering the dynamics of retaliatory crime[29,30]. The simplest model considers crimes occurring in time only:

$$\lambda(t) = \mu + \alpha \sum_{t_i < t} \omega e^{-\omega(t-t_i)} \qquad \textit{Equation 1}$$

Here λ(t) is the probabilistic rate at which crimes occur at the exact instant in time *t*. This rate is the sum of two separate processes. The first process is just the random background rate μ at which crimes occur. In the simplest of models, the background rate does not change through time (or space). Therefore μ is the rate at which crimes occur randomly. Returning to our thought experiment, μ describes the rate at which the light in a room is turned on and off randomly. Such events are random and independent of all other events that have occurred in the past and have no influence on events that occur in the future. They are simply spontaneous random occurrences.

The second process describes self-excitation. In general, self-excitation means that past events make an event at time *t* more likely if they occurred nearby in time and space. The influence of past events decays at a rate of ω. The strength of retaliation or magnitude of excitation is given by α. Imagine that there has been only one crime that occurred in the past at time t_i. If the current instant in time *t* is very soon after t_i then the term in brackets in the exponent will be very close to zero and the summation very close to one. The increase in the rate at which a crime will occur is very close to the maximum it can be α. Now imagine that the current instant *t* is a very long time after the prior crime at t_i. The term in the brackets will be large and the exponential function will be very close to zero. The term α disappears and just the background rate μ is left. The model described above is called a Hawkes process[31] or self-exciting point process[32]. If the self-exciting part is removed, leaving λ(t) = μ, it is a Poisson process.

The problem analyzed here is much more complicated than the simple case described above. Not only is there interest in gang retaliation in both space and time, but there are different types of events that need to be tracked. This added complexity leads to a multivariate spatio-temporal self-exciting point process model:

$$\lambda_u(t,x,y) = \mu_u(x,y) + \sum_{t>t_i} g_{u_i u}(x-x_i, y-y_i, t-t_i). \qquad \textit{Equation 2}$$

Here the probabilistic rate at which crimes occur $\lambda_u(t, x, y)$ for crimes of type *u* at time *t* and location (x, y). In our specific case, there are two crime types, gang crimes known only to the LAPD and gang crimes known to both the LAPD and GRYD IR. Notice now that this is a spatio-temporal model. The random background rate at which gang crimes occurs may vary from place to place μ(x, y), but not in time. The self-exciting process is also spatially dependent with the magnitude of excitation dependent not on how long ago a prior

[29] Mohler, G.O., Short, M.B., Brantingham, P. J., Schoenberg, F. P., & Tita, G.E. (2011). Self-exciting point process modeling of crime. *Journal of the American Statistical Association*, 106(493), 100-108.
[30] Short, M. B., Mohler, G. O., Brantigham, P. J., & Tita, G. E. (2014). Gang rivalry networks via coupled point process networks. *Discrete and Continuous Dynamical Systems*, 19(5), 1459-1477.
[31] Hawkes, A. G., & Oakes, D. (1974). Cluster process representation of a self-exciting process. *Journal of Applied Probability*, 11(3):493-503.
[32] Mohler, G.O., Short, M.B., Brantingham, P.J., Schoenberg, F.P., & Tita, G. E. (2011). Self-exciting point process modeling of crime. *Journal of the American Statistical Association,* 106(493), 100-108.

crime occurred ($t - t_i$), but also how nearby in space ($x - x_i$, $y - y_i$). In general, the closer you are in time and space to a previous crime, the more likely it is to trigger a retaliation. The equations for μ and g are much more complicated than in the simple model, but are designed to capture spatial variation in risk (μ) and spatial-temporal contagion of retaliation g:

$$\mu_u(x,y) = \sum_{i=1}^{N} \frac{\beta_{u_i u}}{2\pi\eta^2 T} \times \exp\left(\frac{-\left((x-x_i)^2 + (y-y_i)^2\right)}{2\eta^2} \right), \qquad \textit{Equation 3}$$

$$g_{u_i u}(x,y,t) = \alpha_{u_i u}\omega \exp(-\omega t) \times \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2+y^2}{2\sigma^2} \right) \qquad \textit{Equation 4}$$

Equation 3 treats the stationary background rate of crimes of type u as a sum of Gaussian kernels. Equation 4 treats the self-exciting effect of one event as decaying exponentially in time and Gaussian in space. Here β is the influence of crimes of type u_i on the stationary background rate for all crimes of type u. So this means that stationary spatial patterns of LAPD-only gang crimes do influence the stationary spatial patterns of LAPD + GRYD IR gang crimes, and vice versa. The parameters η and σ represent the spatial scale of influence for background events and retaliatory events, respectively[33]. The parameter T is the total time period represented by the sample of gang crimes, which in this case is 2014-2015.

The analytical approach is to estimate the parameters of Equation 3 and Equation 4 using data on the occurrence of gang crimes in space and time. Our final target is estimates of g (Equation 4) for the key relationships: (1) the average number of LAPD + GRYD IR gang crimes triggered by a single LAPD + GRYD IR gang crime (a'); (2) the average number of LAPD-only gang crimes triggered by a single LAPD + GRYD IR gang crime (b'); (3) the average number of LAPD + GRYD IR gang crime triggered by a single LAPD-only gang crime (a); and (4) the average number of LAPD-only gang crimes triggered by a single LAPD-only gang crime (b). The procedure used is a type of Maximum Likelihood Estimation (MLE) known as Expectation Maximization (EM)[34]. In conceptual terms, first a reasonable guess at the parameter values for the model must be made. The expectation step of the EM algorithm is used to compute initial probabilities p^b_{ij} and p_{ij} that an event i causes event j via either the background rate μ or the self-exciting kernel g, respectively. These expectations are then fed to the maximization step where a new set of parameter values (for iteration k + 1) are determined by maximizing the expected probability with respect to the observed data. This maximization is done for all the parameters in Equation 3 and Equation 4 taking into consideration whether gang crimes are known only to the LAPD or to both the LAPD and GRYD IR. The algorithm alternates between expectation and maximization until there is no further change in the parameter values.

[33] Short, M. B., P. Brantingham, J. P., Bertozzi, A. B., & Tita, G. E. (2010). Dissipation and displacement of hotspots in reaction-diffusion models of crime. *Proceedings of the National Academy of Sciences*, 107(9), 3961.
[34] Lewis, E., & Mohler, G. (2011). A nonparametric EM algorithm for multiscale Hawkes processes. Preprint:1-16.

For completeness, the EM algorithm is structured as follows.

Complete Data Likelihood Function:

$$Q(\Omega)=\sum_{i=1}^{N}\sum_{j=1}^{N}p_{ij}^{b}log(\frac{\beta_{u_iu_j}}{2\pi\eta^2T}e^{\left(-\frac{(x_i-x_j)^2+(y_i-y_j)^2}{2\eta^2}\right)})-\sum_{u=1}^{U}\sum_{i=1}^{N}\beta_{uu_i}$$

$$+\sum_{j<i}p_{ij}log(\omega\alpha_{u_iu_j}e^{-\omega(t_i-t_j)}\frac{1}{2\pi\sigma^2}e^{-\frac{(x_i-x_j)^2+(y_i-y_j)^2}{2\sigma^2}})-\sum_{u=1}^{U}\sum_{i=1}^{N}\alpha_{uu_i}(1-e^{-w(T-t_i)})$$

Expectation Step:

$$p_{ij}=\alpha_{u_iu_j}\omega\frac{\exp\left(-\omega(t_j-t_i)\right)}{2\pi\sigma^2}\times\frac{\exp\left(-\frac{(x_j-x_i)^2+(y_j-y_i)^2}{2\sigma^2}\right)}{\lambda(x_j,y_j,t_j)}$$

$$p_{ij}^{b}=\frac{\beta_{u_iu_j}}{2\pi\eta^2T}\frac{\exp\left(-\frac{(x_j-x_i)^2+(y_j-y_i)^2}{2\eta^2}\right)}{\lambda(x_j,y_j,t_j)}$$

Maximization Step:

$$\omega^{(k+1)}=\frac{\sum_{j<i}p_{ij}^{(k)}}{\sum_{j<i}p_{ij}^{(k)}(t_i-t_j)+\sum_{u=1}^{U}\sum_{i=1}^{N}\alpha_{uu_i}(T-t_i)e^{-\omega(T-t_i)}}$$

$$\sigma^{2(k+1)}=\frac{\sum_{j<i}p_{ij}^{(k)}\left((x_i-x_j)^2+(y_i-y_j)\right)^2}{2\sum_{j<i}p_{ij}^{(k)}}$$

$$\eta^{2(k+1)}=\frac{\sum_{i,j=1}^{N}p_{ij}^{b(k+1)}\left((x_i-x_j)^2+(y_i-y_j)^2\right)}{2\sum_{i,j=1}^{N}p_{ij}^{b(k+1)}}$$

$$\alpha_{u\hat{u}}^{(k+1)}=\frac{\sum_{l=1}^{n_u}\sum_{t_{i_{\hat{u}_j}}<t_{i_{u_l}}}p_{i_{u_l}i_{\hat{u}_j}}^{(l)}}{\sum_{l=1}^{n_{\hat{u}}}(1-e^{-w(T-t_{i_l})})}$$

$$\beta_{u\hat{u}}^{(k+1)}=\frac{\sum_{i=1}^{n_u}\sum_{j=1}^{n_{\hat{u}}}p_{i_{u_l}i_{\hat{u}_j}}^{b(k)}}{n_{\hat{u}}}$$

The parameter estimates also yield standard errors, which provide a direct pathway to calculating statistical significance (p-values).

Stochastic Declustering

Gang crimes occurring in a given area represent a mixture of those that are that background events and those that are retaliatory in response to other crimes. Events are sorted into these two groups to understand how important background and retaliatory processes are for gang violence overall.

Stochastic declustering is a suite of methods developed in the study of earthquake catalogs where the goal is to distinguish between background seismicity and aftershocks[35]. The same methods can be applied to the study of crime[36,37]

Starting with a self-exciting point process model like the one developed here, stochastic declustering proceeds through a thinning procedure that removes events probabilistically classified as retaliations. The events remaining after thinning represent the background events generated by a spatially non-homogeneous Poisson process $\lambda(t, x, y) = \mu(x, y)$. Specifically, the probability that an event *j* is a retaliation is given by

$$\rho_j = \frac{\sum_{t_i<t_j} g(t_j - t_i, x_j - x_i, y_j - y_i)}{\lambda(t_j, x_j, y_j)}.$$

The probability that an event j is a background event is therefore

$$1 - \rho_j = \frac{\mu(x_j, y_j)}{\lambda(t_j, x_j, y_j)}.$$

For a catalog of *N* total crimes and a point process model fit to those events, the simplest procedure is to generate *N* uniform random variables U_1, U_2… U_N in the range [0, 1]. An event is classified as a background crime when $U_j < 1 - \rho_j$, otherwise it is removed and classified as a retaliation[38].

Note that the assignment of an event to being background or retaliation is a probabilistic classification. On average the relative mixture of background and retaliation events is correct for a given time window and spatial region, but it cannot be said with absolute certainty whether any specific event is or is not a retaliation.

Estimating the Number of Prevented Crimes

The parameter values from the spatio-temporal model can be used to estimate the number of crimes prevented by GRYD IR notifications. The sum (a' + a) is the average number of retaliations known to both the LAPD and GRYD IR produced by our two types of triggers, LAPD + GRYD IR (a') and LAPD-only (a). Similarly, (b' + b) is the average number of retaliations known only to the LAPD produced by our two types of triggers, LAPD + GRYD IR (b') and LAPD-only (b). Note that (a' + a) and (b' + b) are actually measured directly from data and therefore are the observed outcome. Two counterfactual situations can be defined. Let (a + a) be the average number of retaliations that *would have occurred* in the absence of GRYD IR notification for those retaliations known to LAPD + GRYD IR. Here a' is replaced with a second instance of a. Thus, it is supposed that the LAPD + GRYD IR effect is replaced with the LAPD-only effect in the absence of GRYD IR notification. Similarly, let (b + b) be the average number of retaliations that *would have occurred* in the absence of GRYD IR notification for those retaliations known only to the LAPD. Again it is supposed that the LAPD + GRYD IR effect is replaced by the LAPD-only effect in the absence of GRYD IR notification. The relative effect of GRYD IR notification on the average number of retaliations can be computed as:

[35] Zhuang, J., Ogata, Y., & Vere-Jones, D. (2002). Stochastic declustering of space-time earthquake occurrences. *Journal of the American Statistical Association,* 97(458), 369-380.
[36] Mohler, G.O., Short, M.B., Brantingham, P. J., Schoenberg, F. P., & Tita, G.E. (2011). Self-exciting point process modeling of crime. *Journal of the American Statistical Association*, 106(493), 100-108.
[37] Mohler, G., Short, M. B., Malinowski, S., Johnson, M., Tita, G. E., Bertozzi, A. L., & Brantingham, P. J. (2015). Randomized controlled field trials of predictive policing. *Journal of the American Statistical Association*, 10(512), 1399-1411.
[38] Zhuang, J., Ogata, Y., & Vere-Jones, D. (2002). Stochastic declustering of space-time earthquake occurrences. *Journal of the American Statistical Association*, 97(458), 369-380.

Relative effect of GRYD IR notification on LAPD + GRYD IR retaliations	Relative effect of GRYD IR notification on LAPD-only retaliations
$\frac{(a'+a)-(a+a)}{(a+a)}$	$\frac{(b'+b)-(b+b)}{(b+b)}$

For the South Los Angeles GRYD Zones, GRYD IR notification reduces retaliation among LAPD + GRYD IR events by -48.8% relative to the counterfactual (see Table 16 for values of a' and a). GRYD IR notification reduces retaliation among LAPD-only events by -15.0% relative to the counterfactual (see Table 16 for values of b' and b).

These estimated effects with the results of stochastic declustering in South Los Angeles were used to compute numbers of prevented crimes. Stochastic declustering identifies a total of 45 LAPD + GRYD IR gang aggravated assaults and homicides in 2014-2015 as retaliatory (see Table 19). The remaining 577 gang aggravated assaults and homicides are statistically defined as background events. Similarly, declustering identifies a total of 403 LAPD-only gang aggravated assaults and homicides in 2014-2015 as retaliatory (see Table 18). The remaining 877 gang aggravated assaults and homicides are statistically identified as background events. The counterfactual conditions suggest that retaliatory gang aggravated assaults and homicides would have been 48.8% and 15.0% higher in the absence of GRYD IR for events recorded, respectively, as LAPD + GRYD IR and LAPD-only. Thus GRYD IR prevented an estimated total 82.2 retaliatory gang aggravated assaults and homicides. On average, homicides make up 5.4% of all retaliations estimated for homicides and aggravated assaults combined. Thus, in South Los Angeles, the prevented crimes are expected to include 4.4 retaliatory homicides and 77.8 retaliatory aggravated assaults.

McCollister et al.[39] provide a benchmark for the costs of crime. Costs to government are estimated based on the time and effort involved in policing, investigating and prosecuting individual crimes as well as incarcerating offenders. Total costs for victims and their immediate families are based on a combination of court costs and court judgements. The costs to offenders is computed based on lost economic opportunities through incarceration. The total cost of a single homicide to government, victims and offenders is approximately $8.98 million. The cost of a single aggravated assault is $240,000. These numbers are used to calculate the estimated savings from prevented homicides and aggravated assaults.

[39] McCollister, K. E., French, M. T., & Fang, H. (2010). The cost of crime to society: New crime-specific estimates for policy and program evaluation. *Drug and Alcohol Dependence*, 108(1–2), 98-109.