
Investigating Gang Presence as an Environmental Mechanism that Reinforces School Gun Violence



DARTMOUTH

Raine Brookshire

QSS Honors Thesis

Robert Cooper, Advisor

Program in Quantitative Social Science

Dartmouth College

May 7, 2025

Contents

1	Introduction	6
1.0.1	Questions and Hypotheses	9
1.1	Research Motivation	9
1.2	Theoretical Framework	11
2	Literature	13
2.1	Mental Health Mechanisms	16
2.2	Environmental Mechanisms	17
2.3	Gun Access Mechanism	19
3	Hypotheses	21
4	Personal Contribution	22
5	Data	23
6	Methodology	24
6.1	Spatial Model: Inhomogeneous Poisson Point Process (IPPP)	25
6.2	Model 1: Temporal Hawkes Process	27
7	Main Results	28
7.0.1	Model 1: Spatial Regression Model IPPP (2007- 2024)	28
7.0.2	Model 2: Temporal Hawkes Process (2009-2010)	31
7.0.3	Model 3: Spatial IPPP(2009-2010)	32
8	Conclusion	33
8.1	Environmental Mechanisms (Gang Presence) and Socialization Framework .	34
8.2	Spatial Models: IPPP	34
8.3	Temporal Model: Hawkes Process	35

8.4	Linking Space and Time	35
8.5	Limitations and Implications	36
9	Appendix: D3.js Interactive Visualization	41

Acknowledgments

First and foremost, I extend my gratitude to my mother, sister, and grandmother for their unwavering advocacy throughout my academic journey. It is through their enduring support that I have been able to engage with this work without reservation.

I am grateful to my thesis advisor, Professor Robert Cooper, for his intellectual guidance and mentorship throughout the development of this project. Professor Cooper’s thoughtful constructive feedback consistently pushed the boundaries of my thinking and contributed to the clarity of my argumentation.

I also wish to acknowledge Professor Sunmin Kim, whose instruction in Race and Politics profoundly influenced my theoretical grounding in sociological frameworks. Through coursework and discussions focused on the intersection of race and crime, Professor Kim enabled me to think more critically about the broader societal implications of violence.

Special thanks are also due to the faculty and peers in the Department of Political Science and the Quantitative Social Science program, whose intellectual community and commitment to research significantly enriched my academic experience. I am also indebted to the local organizations, public data repositories, and research institutions that made data on school shootings and the presence of gangs publicly accessible. Their transparency and commitment to data integrity formed the empirical basis of this project and made a complex topic more tractable.

This thesis represents an original contribution to the emerging presence of school gun violence studies. As such, I acknowledge the potential for this research to be further developed and formally published, with the aim of expanding scholarly discourse on gangs and school

gun violence. I remain committed to advancing this area of study and potentially intend to pursue future research that builds upon the findings and frameworks proposed in this work.

Finally, I wish to clarify that all visualizations, maps, and coded models included in this thesis were independently created by me.

To my friends, family, and mentors: thank you for sustaining me throughout this journey!

Abstract

Our school system has been increasingly undermined by school shootings. Shootings have risen from **20** incidents in 1970 to **251** in 2021 (American College of Surgeons, 2024)(See figure 2), resulting in the tragic loss of innocent lives. Although, isolated shooters in mass school shooting cases often dominate the media (Education Week, 2021; IOS Press, 2023; JAAPL, 2022), I explore school gun violence through the manifestation of environmental mechanisms. Next, I describe gang presence through gang territories as an environmental mechanism that indirectly influences reported incidents of school gun violence.

Using a **socialization framework**, my study focuses on how school gun violence incidents can involve social group dynamics from gang involvement often overlooked by the media (U.S. Government Accountability Office, 2020). Because Chicago offers data documenting the involvement of gangs in the city through gang territories, this city serves as the basis for investigating the intersection of gang presence and school gun violence cases (Chicago Police Department GIS Portal). Using gang territories as a proxy to determine school gun violence risk, in this study, I pinpoint gang territories, school locations, and gun violence in Chicago to hypothesize how gang territories play a role in the reinforcement of school gun violence incidents.

Using individual school gun violence incidents as the unit of analysis, this research paper examines the link between gang presence (via gang territories) and the school gun violence cases in Chicago. By applying a **Gun Violence Interaction Model (GVIM)** I developed (See Figure 1) and by taking into account theoretical applications of the socialization framework, I analyze how gang territories contribute to increased risk of school gun violence incidents.

Keywords: Socialization Framework, Gang Territories, Gang Presence, Social Learning and Strain Theory, Spatial/ Temporal Inhomogeneous Poisson Point Process, Hawkes Process

1 Introduction

From 1970 to 2021, school shooting incidents **quadrupled** over the past 53 years and shooting deaths increased more than sixfold, from 0.16 to 0.97 per 1 million population, according to Homeland Defense and Security (CHDS). High-profile incidents, such as a 14-year-old in Georgia killing four people in 2024 (Riess et al., 2024) and an 18-year-old killing 19 children and two adults in 2022 (Despart, 2023), often dominate media coverage.

Although, this study focuses on the less-publicized, smaller-scale school gun violence incidents, I explore a socialization¹framework to examine how school gun violence manifests from environmental mechanisms. These mechanisms—often overlooked in earlier work—are community-specific and, I propose, closely tied to gang presence.

One such heartbreaking gang- involved incident occurred in Oakland, California, in 2022, when a drive-by shooting erupted on a school campus, injuring students and staff (Lambert et al., 2022). When compared to typical publicized school shootings that entail random killings and high death counts, the school gun violence cases derived from the Chicago datasets include robberies, disputes, and targeted instances within the community.

Looking deeper into the mechanisms that cause a shooting to occur, I use an analogy of the "fire triangle". Because the three components necessary to create a fire are fuel, oxygen, and heat (Blazequel, 2024), I propose that school gun violence² is driven by three critical elements: **firearm access**, **environmental conditions**, and **mental health status**. Each of these elements aligns with the fire triangle as follows:

¹Socialization is defined as the process by which individuals learn and internalize the norms, values, behaviors, and social skills according to Harvard research assistant Charlotte Nickerson.

²Following conventions in recent literature, I distinguish school gun violence—any incident involving a firearm on or near school grounds (300m-1000m)— from school shootings, which typically refer to incidents on school property where a firearm is discharged with the intent to kill or injure.

First, the fuel provides the combustible material needed for fire, so firearms represent the physical means through which violence is enacted. Without access to guns, the likelihood of a gun violent outburst resulting in mass harm is drastically reduced. Therefore, a gun can be conceptualized as the fuel to gun violence incidents. Next, mental and emotional instability acts as the heat source, increasing psychological volatility. Similarly to how heat brings fuel to its ignition point, negative mental health can catalyze the turn of an individual to gun violence. Finally, the environment acts as the oxygen, supplying the often-unseen conditions that sustain the system—such as community dynamics, socioeconomic pressures, gang disputes, and exposure to violence. Like oxygen in a fire, these factors are already externally present and can intensify the conditions under which a gun violence incident develops.

Together, these components form what I refer to as the Gun Violence Intervention Model (See figure 1). This model implicitly emphasizes that similar to fire prevention, effective intervention requires the disruption of at least one of the three components. However, effective prevention requires simultaneously addressing all three elements: limiting firearm access, improving mental health support, and mitigating environmental risk factors. Yet, existing literature has largely overlooked the role of the environmental conditions in shaping school gun violence.

In relation to the environmental mechanisms at play in school gun violence, the GAO found that shootings at K-12 schools often resulted from disputes or grievances between students or gangs, with 31 % originating from gang-related violence in schools (U.S. Government Accountability Office, 2020). Thus, the GAO’s finding lends empirical weight to the argument that school shootings are not only behavioral or psychological phenomena, but are often manifestations of gang-related violence rooted in social dynamics.

Gangs as social groups have been a part of American society for centuries with some of the oldest gangs dating back to the early 19th century (SAGE, 2023). Gangs have been growing in smaller cities, not just “big cities”, (National Institute of Justice, 2017: p. 109)

and due to the distribution of drugs and weapons, these gangs (p. 21) have been fortifying control over their territory³ by any means necessary through murder, extortion, drive by shootings, and chaos (U.S. Department of Justice. The Problem of Drive-By Shootings, 2020; Curry & Decker, 2003).

According to the National Youth Gang Survey, it is reported that between 2015 and 2024, annual estimates of gang members have averaged around 770,000 nationally, with a notable 8.6% increase to approximately 850,000 in the most recent year (National Gang Center, 2024). Furthermore, these gangs often engage in delinquent behavior⁴ which ranges from property crimes (such as theft and vandalism) to more serious offenses like assault, drug trafficking, and illegal firearm possession. Research indicates that gang members are disproportionately involved in such behaviors, accounting for approximately 86% of serious delinquent acts, 69% of violent delinquent acts, and 70% of drug sales (Office of Juvenile Justice and Delinquency Prevention, 2024). These statistics underscore the systemic role that gang affiliation plays in the shaping on an environment where criminality is normalized, particularly among youth populations.

Youth gang violence, as an environmental mechanism, has been shown to contribute to higher levels of community disorganization⁵ and social fragmentation⁶ through delinquent behavior (Shaw & McKay, 1942). From this narrative, coupled with the normalization of gang culture in schools (Taylor, 2001) and influence from social learning⁷, it becomes clear that gang violence not only disrupts community structures but also perpetuates a

³Gang territory is used consistently in this research, as it is the most commonly adopted term in the literature to account for gang presence. However, alternative terms such as gang boundary or gang regions exist, though these may imply a less threatening interpretation of gangs as merely occupying a defined space.

⁴Actions that violate the law or established social norms and encompass a wide spectrum of unlawful or antisocial activities, particularly when committed by individuals under the age of 18.

⁵Community disorganization refers to the breakdown of social institutions (e.g., family, school, local government) and weakened informal social controls, often resulting in higher crime rates and reduced collective efficacy. (Shaw & McKay, 1942).

⁶Social fragmentation denotes the weakening of social bonds, trust, and cohesion within a community, often characterized by residential instability, poverty, and ethnic heterogeneity, which can hinder collective action.

⁷Social learning theory posits that individuals learn behaviors, values, and norms through interactions and observations of others, especially within peer groups. In the context of gangs, delinquency is often learned and reinforced through group dynamics. (Akers, 1996).

cycle of learned violence within educational environments. I argue that the environmental mechanism of gang violence fits into the Gun Violence Interaction Model (GVIM), and indirectly facilitates the emergence and reinforcement of gun violence instances within school environments.

1.0.1 Questions and Hypotheses

With gang violence on the rise, what are the underlying mechanisms that connect gang presence to school gun violence, and how does the involvement of gang territories shape the likelihood of shootings occurring near schools?

This research employs a quantitative approach to investigate the intricate relationship between gang presence and school gun violence, with a specific focus on understanding how violence in gang territories contributes to a heightened risk of gun violence within school environments due to a “spill over” effect. Although there has already been emergent body of scholarship on school gun violence (Muschert, 2007; Roque, 2012; Sommer, Leuschner, & Scheithauer, 2014; Wike & Fraser, 2009), this research to date suffers from crucial limitations (Grøndahl & Bjørkly, 2016). Major limitations involve the inherent lack of quantitative data and scientific theorizing on the subject. This study aims to answer both theoretical and quantitative questions under-examined to date.

1.1 Research Motivation

Rising school shootings have raised widespread concern (Durham, 2024) and current narratives surrounding school gun violence are heavily centered on gun control and mental health, which are both components of the GVIM framework (See Figure 1). Evidence suggests that strict gun laws alone have not significantly reduced the number of school shootings (Jenna Ahn, 2018). On the mental health front, research often emphasizes isolation and psychological distress, but these narratives do not address the full spectrum of contributing factors (based on group dynamics). Specifically, they tend to neglect the influence of environmental

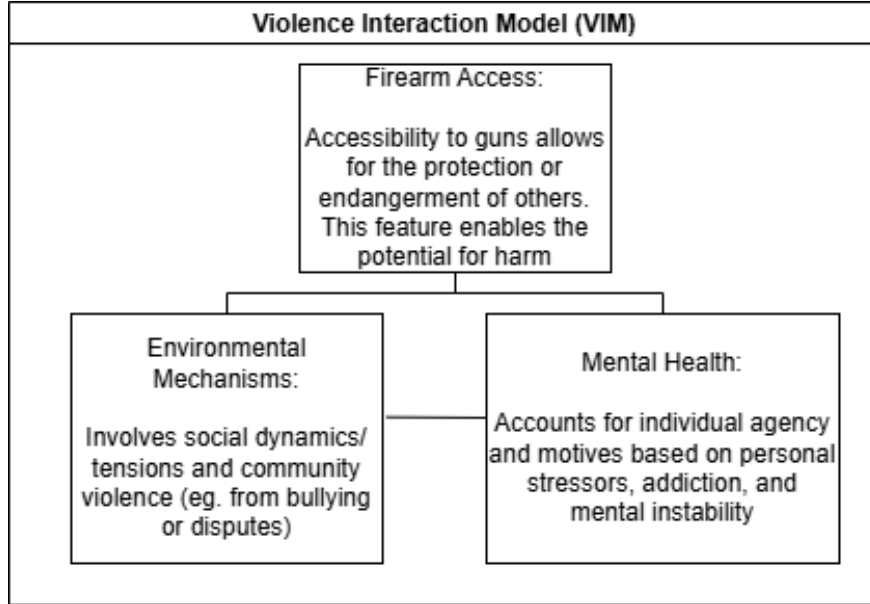


Figure 1: The constructed GVIM depicts how general gun violence arises from the interaction of three components—gun access, social conflict, and mental health (stressors/ addictions/ instability). While borrowing from the "fire triangle", it emphasizes that the combination of these factors, rather than any single one, creates the conditions for a shooting incident.

mechanisms such as gang presence. Additionally, school shootings have mostly been viewed qualitatively, but with the vast number of shootings, currently a quantitative assessment of this timely issue seems more necessary,

Gang violence has been shown to negatively impact youth mental health and serves as a conduit through which high school students may gain access to firearms and drugs, thereby increasing the risk of violence (Howell, 2011) while interacting with the other mechanisms within the GVIM. With the availability of data on gang territories being taken into account, Chicago is a location of attraction (Federal Bureau of Investigation, 2011). Preliminary evidence also suggests that the normalization of gang culture—disseminated through music, media, and peer influence—can manifest as violence, contributing to smaller-scale school shooting incidents (Kubrin, 2014).

Building on this perspective, my research focuses specifically on gang territories, school locations and gun violence in Chicago. This city, long recognized for its complex gang history, offers a valuable context in which to examine how territorial shifts influence patterns of gun

violence. By analyzing the evolution of gang territories in tandem with school locations and recorded shooting incidents, I aim to generate deeper insights into how these shifting geographies exacerbate the risk of school-based gun violence. Through mapping and spatial analysis, this case study will uncover the intersection between gang territories and school gun violence.

This study is motivated by the the lack of extensive research on the intersection of these two issues. Many school shooting cases also operate within the isolation rampage style narrative, but I propose a socialization framework. I discuss this dynamic through gang activity whereby gang members socialize and thus assimilate into harmful culture and become negatively influenced by their peers, resulting in increased delinquent, lawless, and defiant behavior (Taylor, 2001).

The goal of my work is to provide evidence in support of a newly developed socialization framework and Violence Interaction Model that indicates gang territories (within environmental mechanism) as a contributor of school gun violence. The hypothesis develops as such: Schools located within or adjacent to gang territories experience significantly higher rates of school gun violence than those outside gang-controlled areas.

1.2 Theoretical Framework

The increase in school shootings has ignited widespread debate about the key factors driving this trend. While firearms play a central role in these incidents, the societal conditions influencing school shootings—such as exposure to gangs warrant closer examination. Revisiting the fire triangle analogy, firearms represent the fuel, the individual’s mental and emotional state constitutes the heat, and the societal environment—particularly the presence of gang violence—serves as the oxygen that sustains and exacerbates the potential for violence. Is the surge in school shootings primarily fueled by the availability of firearms, or do deeper social and cultural factors—such as an exposure to gang violence—serve as the “oxygen” that also sustains and exacerbates this crisis?

This section will delve into the interpretation of the socialization framework and while a prior study of mine on mass shootings assessed the interaction between guns, shootings, and motives, it lacked a connection to gang and school gun violence, as mass shootings account for less than 1 % of shootings of all firearm deaths, a relatively rare subset of all gun violence. (DeLateur, 2014). Many shootings already occur in regions with high levels of gang activity (Fornaris, 2018). This raises a crucial question: Is it a mere coincidence that school shootings frequently occur in gang infested areas, or is this an indication of a deeper underlying mechanism?

To understand the impact of gang presence on school gun violence, my analysis adopts the theory within social disorganization theory and strain theory. Social disorganization theory posits that communities with weakened social institutions—such as schools, families, and law enforcement—are more susceptible to crime and violence (Wickes 2017). Areas with high gang activity often exemplify these characteristics, creating environments where violence becomes ingrained in the social fabric and perceived as a normative response to conflict or frustration (Shaw et al., 1942). Children in such areas are frequently exposed to violence, whether directly or indirectly, and may come to view violent behavior, including shootings, as an acceptable form of self-expression. This normalization of violence can have devastating consequences, particularly when it manifests in schools.

For this study, I draw motivation from the social identity theory and social learning theory, which involves elements of peer pressure and conformity. While social disorganization theory provides a strong foundation for examining the relationship between gang activity and community violence (Sampson 1997) it does not fully address school gun violence and the personal and psychological dimensions of this issue. For instance, it overlooks how individuals experiencing a profound disconnect between societal expectations and the means to achieve them might turn to violence. This gap is effectively bridged by strain theory, which explains that individuals who feel alienated or blocked from achieving societal goals may experience frustration and resort to deviant behaviors (Agnew 1992).

Involvement in criminal behavior is significantly higher for gang involved youth compared to non-gang youth (Esbensen, C. A., & Weerman, F. M. 2005). Meanwhile, the higher a respondent's estimate of the likelihood of getting caught, the less likely they are to be involved in criminal and violent activities. This, combined with the idea that gang identity is intertwined with gang loyalty, shows that gang members are not fearful of getting caught and identification with a gang can trump personal interests such as concerns about getting caught and punished. On the involvement of the social identity theory, this theory focuses on inter-group dynamics rather than interpersonal and while based on the personal layer of one's self- concept, Virgil (1988b) emphasizes the contribution that gang membership makes on one's self-definition.

2 Literature

In this following section, I outline definitions and debates surrounding the history of gangs and mechanisms contributing to gun violence in schools. First, I assess how isolation and socialization are factors in the development of school gun violence incidents. Second, I synthesize prior literature and outline social theories of how membership in gang settings influence overall gun violence and school- related shootings.

While my research focuses on school violence incidents, to document existing literature on school shootings, first I must define a school shooting. According to the k-12 database utilized in this study, a school shooting occurs “when a gun is fired, brandished (pointed at a person with intent), or a bullet hits school property, regardless of the number of victims, time, day, or reason” From this, I inquire causal mechanisms that are involved in the enactment of this type of violence.

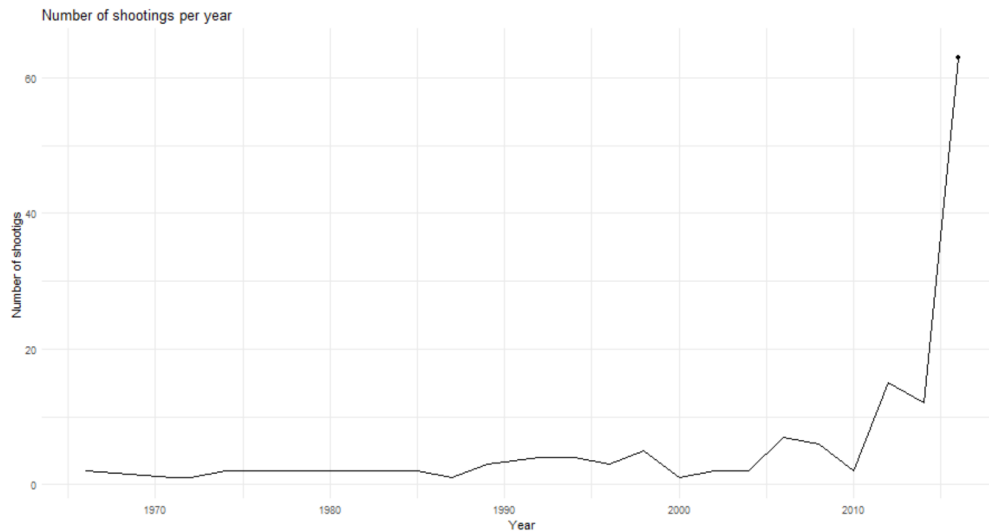


Figure 2: This visualization created in R depicts statistics from the American Academy of Pediatrics. The number of school shootings has been rising, with a total of 1,453 incidents. Of these, 794 occurred between 2017 and 2022, compared to 135 shootings in the previous 15 years combined (Rapa & Durham,2024)

School Shootings: Isolation vs Socialization Narratives

On the matter of mechanisms influencing school shootings, Brent R. Klein notes that there are two types of decisions when it comes to these shootings. He details a “dual process”, which relates to cognitive decision-making mechanisms based on mental processes of system 1 (typically with multiple shooters socially engaging to enact shootings) or system 2 processes (a single shooter usually differentiated by antisocial development) (Klein, B, 2020). Klein describes a “system of choice” which categorizes shooters into two systems- one involves quick automatic mental processes whereas the other is slower, conscious and more deliberate. In this regard, I direct my research vision heavily towards the 1st system.

Because isolation cases are involved in system 2 instances, I assert that the socialization cases involve system 1 cases. Not only are heavily publicized school shootings the result of isolation cases frequently described by the system 2 pathway, but I argue that the socialization framework interacts with the system 1 pathway. The system 1 pathway can also be specified to gang affiliated shootings, because when gang disputes erupt quickly in groups (Decker, 1996) they contribute to higher levels of violence within the community (National

Gang Threat Assessment, 2011). Little research has explored the system 1 pathway, which I hope to expand on.

Moreover, while the isolation narrative has been heavily discussed in mass school shootings, in 2023 it was argued that "most school shootings aren't mass killings... and are often driven by community violence" (Musa, 2023). To support my argument of socialization based on environmental mechanisms at play, Dr.Chethan Sathya, a trauma director at the Cohen Children's Medical Center, differentiated group shootings from isolated cases (eg. mass shootings) which frequently involved manifestos. Additionally, she discussed how there are violent gang- related shootings that are driven by community violence and do not usually fit the role of "typical" school shootings. I study aspects of these nuanced type of shootings near school settings, which I refer to as school gun violence incidents from here on out.

The isolation narrative based on system 2 contrasts the socialization framework I propose, which relates to Klein's system 1 pathway. Research indicates that social dynamics influence general shootings. In the context of domestic violence (DV), 59.1% of shootings between 2014 and 2019 were DV-related, and in 68.2% of these shootings, the perpetrator either killed at least one partner or family member or had a history of DV (Geller, Booty, & Crifasi, 2014). This study highlights the crucial role domestic violence can play in shootings within the U.S.A. While DV-related shootings were linked to fewer casualties, they exhibited a higher case fatality rate (CFR). Specifically, domestic violence shootings resulted in a 32.6% increase in CFR compared to non-DV-related incidents. Although this study focused on domestic violence and general shootings, its findings of how social dynamics relate to shootings become critical. I am interested in exploring the group dynamics of gangs through their presence and researching how territories surrounding these gangs influence school gun violence within these regions.

Klein discussed the system 2 pathway, which can be used to describe slow and deliberate cognitive processes. It involves conscious reasoning and effortful decision-making. In contrast to automatic responses associated with system 1 thinking, system 2 is engaged when

individuals carefully plan to participate in a shooting. The system 2 pathway suggests that the perpetrator may have engaged in extended planning and calculated decision-making, rather than acting on sudden impulse or emotion seen in system 1 cases.

The narratives within the media of mass shootings often appeal to system 2 pathways, where the shootings are usually well thought out and developed over a longer period of time (Klein, 2020). However, this system is still predicated by the involvement of firearm accessibility (Kleck & 1993), community/ household stressors, and mental health factors (Lankford, 2016). I argue that to fully conceptualize the nature of all school gun violence, researchers must consider the involvement of group dynamics (system 1 cases) to account for the continuous occurrence of these shootings.

I examine gangs and their tendency to commit gun violence by specifically examining instances of gang territorial expansion or contraction as the treatment and school gun violence rates as the outcome. Utilizing these changes in gang territory coverage, I assess its effect on school gun violence frequencies (See Methods Section). While previous research disproportionately focused on analyzing the characteristics of perpetrators of highly publicized, rampage style school shootings (also known as multiple-victim shootings) (Burns & Crawford, 1999), I examine gang presence (via gang territories) as an environmental mechanism that increases the expected rate of school gun violence incidents. The most prominent research findings for past rampage school shooters reached this conclusion: **“school shooters tend to be male and white”**. However, for smaller school gun violence incidents, which may occur due to gang rivalries, a distinct narrative based on race and socioeconomic status suddenly emerges.

2.1 Mental Health Mechanisms

Studies have identified mental health challenges, isolation, firearm access, and broader community dynamics as key factors influencing school gun violence (Leiner et al 2018; McNeill 2023; Reeping 2022; Meindl 2017). Within these community dynamics, gang violence driven

by environmental mechanisms play a significant yet unexplored role. Drug use and the high-pressure social environment gangs exist in further deteriorate members' mental health (Hennigan et al., 2015), creating feedback loops that intensify violent behaviors and exacerbate the broader impact of gang culture on communities. While there has been the glorification of gang communities inadvertently influencing negative behaviors, this normalization and glorification of violence is often perpetuated by group interactions, social media, music, television, and graffiti art (Lozon, J., & Bensimon, M. 2017; Office of Community Oriented Policing Services, 1999).

Research in gang settings has shown that gangs cause a reduction in test scores (National Gang Center, 2021) and increase lawlessness and delinquency (Office of Justice Programs, 2021). Delinquency as a component of mental health is accounted for in the GVIM where mental health mechanisms result from the portrayal of gang culture in the media . For example, the media falsely represents gangs as admired "gangstas" that play a supportive and protective role in the community (Kubrin, 2014). However, these narratives deepen the glorification of gang culture as gangs continuously try to enact harm, gain territory as a show of dominance and power. These narratives lend value to the seriousness of environmental mechanisms within gang territories that augment online perceptions influence mental health mechanisms.

2.2 Environmental Mechanisms

Although gun control and mental health are undeniably crucial in addressing school shootings, this study proposes an additional factor: the impact of gang presence. Chicago, home to one of the largest gang populations in the United States, provides a unique case to explore the intersection of gang dynamics and school gun violence. With the rise of gangs in suburban areas, gang-related shootings may influence youth behavior in ways that exacerbate school shooting incidents. To discuss the history of gangs, we first have to define what a gang is. There are multiple definitions of gangs (Klein & Maxson 1989, p.211; Klein 1971,

p.13; Curry & Spergel 1988, p.382; Fleisher 1998, p.257) but according to Fleisher, gangs are “one delinquent subgroup along with other homogeneous adolescent subgroups: skaters, preps, hip-hop, ravers, goths and stoners” (Fleisher 1998, p.257).

In terms of the history of these groups, a majority of the Chicano gangs in Los Angeles, for example, can be traced to the settlement patterns of Mexican immigrants. While socially isolated they lived in sub par environments like the barrios - homes occupied by more people per household. From this, researchers have shown how urbanization often creating certain social classes leaves communities more subject to human disorganization (Thrasher 1963 ; Shaw and McKay 1942)

Ever since the late 20th century, gangs have wreaked havoc within the criminal justice system. For gang members, violence is a way of life. Gang members would typically wear identifying “colors” as a rag of a specific color hanging from their back pocket, and flash “signs” to intimidate and signify gang affiliation (Howell, 2010). These colors and signs have ties to music and gang portrayal in the media. Members usually incorporate a certain style (such as bandanas), partake in graffiti, “throw up” gang signs to note affiliation, and use language as a means of identification. These can all be attributed to social learning theory, which at the elementary level employs the idea of “monkey see monkey do” (Bandura, 1977).

In some sense, the framework and operation of gangs can range from loose-knit affiliations to quasi-militaristic units with distinct ranks and responsibilities. From prior research, it is clear that gangs are malicious, and at the root, they intend to “get even” with rival gangs (Decker, S. H., & Van Winkle, B. (1996). These systems are rooted in generational trauma and may involve system 1 instances. Due to the dangers of “the streets”, gang members have created a system of intimidation using media where a firearm is critical to their survival (digitally and physically) as they make use of words describing their “opps” to be “lacking” when they are unequipped with a firearm. (Pinkney, C., & Robinson-Edwards, 2018).

This issue may not be limited to cities like Chicago. For instance, Portland recently faced

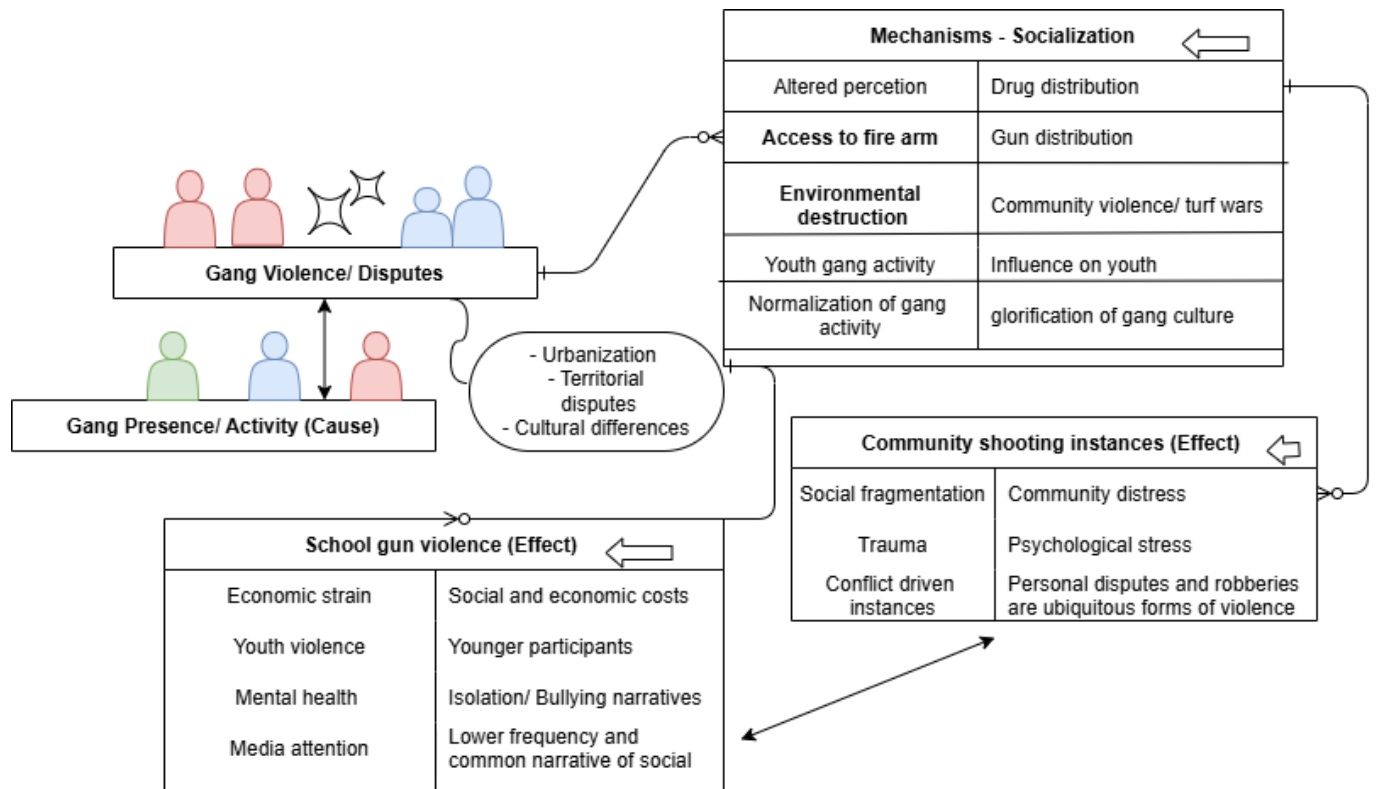


Figure 3: This flowchart I created using draw.io showcases gang activity and its potential interaction with community and school gun violence.

a gun violence crisis, with 50% of gun homicides in 2021 linked to gang violence. While the police force initially concluded that a gun prevention act would be the most effective approach, the city later disbanded the force and failed to address the long-standing gang populations, which have become a significant liability to the community (NBC5. *Portland's Gun Violence Isn't Just a Gang Problem*. YouTube video, 3:45. Published October 5, 2021).

2.3 Gun Access Mechanism

While gun laws are often discussed in terms of accessibility and regulation of firearms, restrictive gang laws that target gang membership and harmful gang activities play a pivotal role in reducing the influence gangs have over vulnerable youths. Gun laws that regulate firearm access among minors and individuals with criminal backgrounds also help prevent easy access to weapons that might otherwise be used in violent school incidents as many shootings

involve getting weapons from family members or the illegal market (National Institute of Justice. 2021). The involvement of gang members in school shootings and community violence is closely linked to their access to firearms, and an emerging threat in this context is the rise of ghost guns. These untraceable firearms, often assembled from parts purchased online, pose a significant challenge to gun control measures and are increasingly being used by young gang members to perpetuate violence (U.S. Department of Justice. 2020).

A 2022 report from the Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) found that the number of “ghost guns”⁸ recovered by law enforcement had increased by more than 10 times from 2016 to 2021. These weapons are particularly popular among youth gang members due to the ease with which they can be acquired and assembled. Ghost guns are often sold online or in unregulated markets, bypassing traditional gun control measures such as background checks. Because they are untraceable, gang members can use them without fear of law enforcement tracking their firearms to criminal activity, making it more difficult for gun laws to restrict their access to firearms.

Because gang members are often expected to carry weapons to prove their commitment to the gang and their readiness to engage in violence when necessary (Decker & Van Winkle 1996), not having a gun can be seen as a weakness, resulting in a loss of respect and pose a potential threat to their personal safety. Members of rival gangs or even individuals within the same gang can escalate conflicts quickly (Klein’s system 1 pathway), and having a weapon is a means of self-defense. The absence of a weapon in these contexts can result in physical harm, death, or being targeted by other members (The Gun Violence Archive 2021). I explore this involvement gangs and guns on the occurrence of school gun violence and while gaps have already been filled between gangs and illegal guns access, I bridge the gap between school gun violence and gang presence.

⁸Ghost guns are privately made firearms that lack serial numbers and are often assembled from kits or 3D-printed parts, making them untraceable by law enforcement.

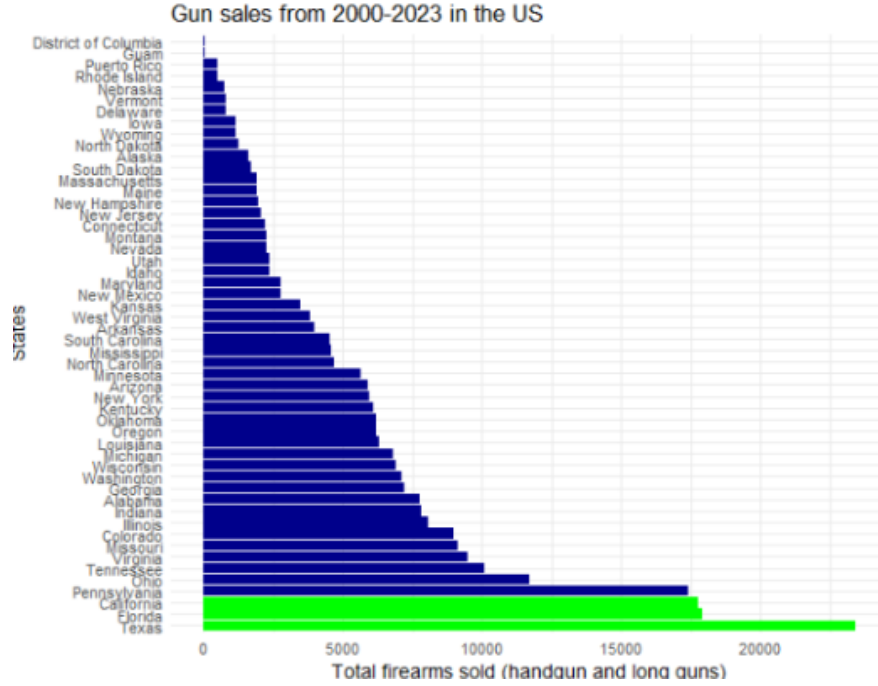


Figure 4: Visualization documenting gun sales per state (in github).

3 Hypotheses

The increase in school gun violence (Rapa & Durham, 2024) and the growing prevalence of gangs (National Gang Center, 2024) underscore the need for a more nuanced analysis of these interconnected issues. This study aims to bridge the gap in existing research by examining how gang presence reinforces school gun violence in Chicago. This research tests the major hypothesis that increased gang presence (via gang territories) indirectly contributes to the prevalence of school gun violence.

Major Hypothesis: School Gun Violence

Null Hypothesis (H0): The rate of school gun violence is equal in areas inside or near gang boundaries and in areas outside gang boundaries. Alternative Hypothesis (H1): The rate of school gun violence is significantly higher in areas inside or near gang boundaries compared to areas outside them.

Minor Hypothesis: General Gun Violence

Null Hypothesis (H0): The rate of shooting incidents is equal in areas inside or near gang boundaries and in areas outside gang boundaries. Alternative Hypothesis (H1): The rate of shooting incidents is significantly higher in areas inside or near gang boundaries compared to areas outside them.

4 Personal Contribution

Although the influence of gangs on community disorganization is clear (Howell, 1998; Miller, 1982), little research has assessed the characteristics of gangs negatively influencing school environments specifically based on gun violence. In this study, I hypothesize that gangs act as an environmental mechanism that influence school environments through socialization (pg. 14). To contribute to current literature, I use Chicago as a case study and generate spatial Poisson point process models to link the *treatment* (gang territorial presence) to the *outcome* (frequency of school-proximate gun violence incidents).

While the influence of gangs on neighborhood disorder is well documented (Howell, 1998; Miller, 1982), little work has evaluated how the spatial distribution of gangs via gang territories affects school environments . I utilize a spatial Inhomogeneous Poisson Point Process (IPPP) to capture trends from 2007 to 2024 to document the effect of gang territories on school gun violence.

My prior research examined the top 3 states with the highest number of shootings - California, Texas, and Florida (https://github.com/Rxbrooks15/Gang_Territory_Honors_Thesis/tree/main). World population review also indicates these as the top 3 states with the most school shootings. In my previous study, I analyzed the extent to which high gun sales and gun accessibility related to increased school shootings. I included graphs that highlighted the types of shootings recorded. However, in my study I primarily focused on mass shootings, which falls under the isolation framework and system 2 narrative (Klein, 2020).

While pro-gun states are more prone to school shootings due to weaker gun laws (Everytown for Gun Safety, 2024), this narrative lacks consistent quantitative support. Jenna Ahn notes in her 2018 Notre Dame paper that U.S. states with strict gun laws like California and Minnesota still experience high rates of school shooting casualties, challenging the assumption that stronger gun laws always lead to fewer incidents (Jenna Ahn, 2018). Ahn asserts that various factors such as socioeconomic status, race, propensity for violence, mental health, gender, and access to school resources get overlooked in school shootings. While research has extensively examined these elements, it is Ahn’s concept of a person’s “propensity for violence” that particularly captivates my interest. I argue that this propensity for violence is deeply rooted in gang affiliation and not only exacerbates, but also perpetuates the occurrence of school gun violence incidents.

5 Data

To represent the presence of gangs, I utilize gang territory shapefiles provided by the Chicago Police Department’s GIS portal. This geospatial dataset spans from 2007 to 2024 (excluding 2013) and outlines estimated gang-controlled zones across the city. The independent variable—gang presence—is determined by these gang territory shapefiles, allowing for spatial variation in intensity across neighborhoods. The primary dependent variable and unit of analysis—school gun violence incidents—is measured using a combination of incident-level data from the *K-12 School Shooting Dataset* (Kaggle), the *Gun Violence Archive (GVA)*, and *Chicago Gun Violence Dataset*. These incidents are spatially matched to school locations with buffer zones (Figure 5) drawn from official public and private school geolocation data compiled from the Chicago Data Portal.

I incorporate the full *Chicago Gun Violence Dataset* 2001 to the present (1991 to present for Homicides), which logs all reported gun violence and gun-specific homicides. Covariate data aggregated from 2017 ACS 5-year estimates indicate covariates of race, household in-

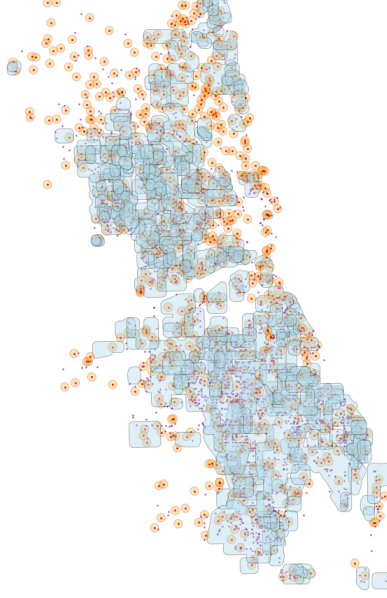


Figure 5: Pre- Inhomogeneous Poisson Point Process setup where a 300m buffer zone exists for both gang territories and Chicago school locations . Yellow regions enclose school locations, blue regions enclose gang territories and purple dots depict example shootings in 2007.

come, and total populations by Chicago ward; however, this data only exists for the year 2023. This data is not viable for a longitudinal study from the years 2007- 2024 since yearly changes are not accounted for.

6 Methodology

Using Chicago as a observational case study, I generate spatial and temporal Poisson point process models to link the treatment (gang territories) to the outcome (school gun violence incidents). I apply two spatial Poisson point process models and a Hawkes process to investigate the relationship between gang territories and the distribution of school-proximate shootings. While the link between gangs and community disorder is well established (Howell, 1998; Miller, 1982), limited work has evaluated how gangs influence school environments through the lens of gun violence.

Chicago Gang Territories - 2009

Chicago Gang Territories - 2010

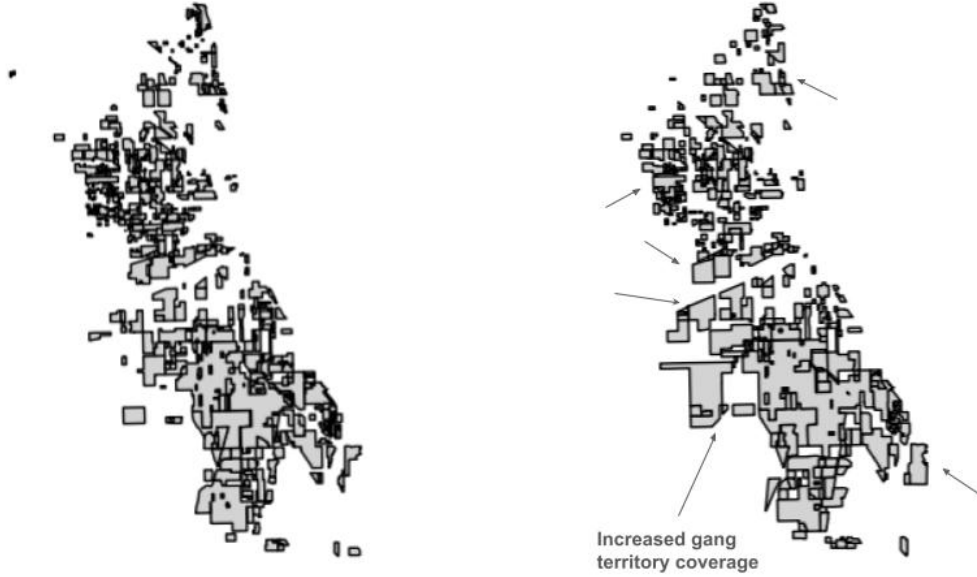


Figure 6: Gang territorial expansion in the years 2009 to 2010. These were the two years where the gang territories increased. There appears to be several overlapping gangs in the northwest and south sides of Chicago.

6.1 Spatial Model: Inhomogeneous Poisson Point Process (IPPP)

To understand the IPPP let $s \in \mathcal{S} \subset \mathbb{R}^2$ denote a location in Chicago. The number of shooting events in any spatial subregion $A \subset \mathcal{S}$ is modeled as a Poisson point process:

$$P(N(A) = k) = \frac{(\int_A \lambda(s) ds)^k}{k!} \exp\left(-\int_A \lambda(s) ds\right) \quad (1)$$

where $\lambda(s)$ is the spatial intensity function, representing the expected number of shootings per unit area at location s . I model $\lambda(s)$ using a log-linear formulation:

$$\lambda(s) = \exp(\beta_0 + \beta_1 \cdot \text{GangTerritories} + \beta_2 \cdot \text{SchoolLocation}(s) + \varepsilon(s)) \quad (2)$$

While variables can be rasterized over a uniform grid (300m \times 300m) using a projected coordinate system (EPSG:26971), this can be computationally expensive. Therefore, I utilize buffer zones for school locations and gang territories (Figure 7).

34 Million m² Square Centered in 2023 Chicago Boundary

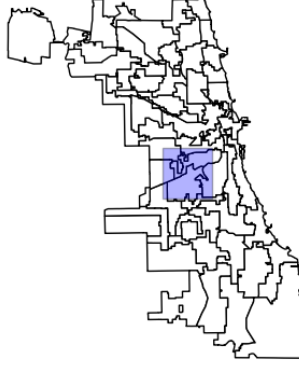


Figure 7: There is a decrease in gang territory from 181,839,888.18 sq meters to 162,922,345.25 sq meters in Chicago. (Note: the 34,000,000 meter squared reduction in the gang territory coverage from 2007- 2024 is the size of about 4,400 football fields!

To assess spatial heterogeneity in gun violence incidents, particularly in relation to gang territories, I use the conditional density of locations given a fixed number of events within a bounded region B . This is defined as:

$$f(x_1, \dots, x_n \mid N(B) = n) = \prod_{i=1}^n \frac{\lambda(x_i)}{\int_B \lambda(x) dx} \quad (3)$$

Given n events in B , the event locations are assumed to be independently and identically distributed with a density proportional to $\lambda(x)$, capturing spatial variation in shooting intensity.

To estimate the intensity function $\lambda(x)$ non-parametrically, I apply the kernel smoothing method:

$$\hat{\lambda}(x) = \frac{1}{nh^2} \sum_{i=1}^n K\left(\frac{x - x_i}{h}\right) \quad (4)$$

Here, x_i are observed shooting locations, $K(\cdot)$ is a smoothing kernel (typically Gaussian), and h is the bandwidth. The IPPP heatmap (pg. 30) visualizes this estimated intensity surface $\hat{\lambda}(x)$, with brighter areas indicating higher expected shootings per square meter.

Since the number of shootings in any region B is modeled as:

$$N(B) \sim \text{Poisson} \left(\int_B \hat{\lambda}(x) dx \right) \quad (5)$$

areas with larger values of $\int_B \hat{\lambda}(x) dx$ are expected to experience more gun violence incidents. The alignment of high $\hat{\lambda}(x)$ values with gang territories supports the hypothesis that spatial clustering of shootings near schools is reinforced by gang presence (See page 30).

6.2 Model 1: Temporal Hawkes Process

To assess temporal dependencies in shooting incidents, a self-exciting Hawkes process is fitted to daily shooting event times from 2009 and 2010. The Hawkes model estimates the conditional intensity $\lambda(t)$ of shootings at time t as:

$$\lambda(t) = \mu + \sum_{t_i < t} \alpha e^{-\beta(t-t_i)} \quad (6)$$

where μ is the background rate, α is the excitation parameter quantifying how one shooting increases the likelihood of another, and β determines how quickly this influence decays over time.

4.3 Differences Between the IPPP and Hawkes Process Model

A key component of the Hawkes process is its cumulative intensity function, defined as:

$$\Lambda(t) = \int_0^t \lambda(s) ds \quad (7)$$

which gives the expected number of shootings by time t . This function is useful for simulating events, forecasting future shootings, and testing model fit.

To intuitively understand $\Lambda(t)$, imagine counting cars on a road. If cars pass at a constant rate, your count increases linearly. But if one car is followed by many others in a jam, the count increases more steeply. This “jamming” process mirrors the self-exciting property of

the Hawkes process, where one shooting may trigger another soon after.

In contrast, the IPPP assumes spatial independence between events. Its cumulative measure is static or location-dependent and does not evolve from prior events. The IPPP is like counting cars that appear independently across various streets, without one car influencing the appearance of another.

Together, these models offer complementary insights: the spatial IPPP reveals **where** shootings cluster, while the temporal Hawkes process reveals **when** shootings are likely to recur after an initial incident. Used in combination, they provide evidence that school gun violence in gang-affiliated areas exhibits both spatial concentration and temporal escalation. While a temporal Hawkes process and spatial IPPP are still robust, a spatio-temporal model would be superior to both models.

7 Main Results

This study first employs a spatial regression model to examine the relationship between gang territorial presence and the frequency of school-based shootings. This spatial approach allows for the integration of georeferenced data, wherein individual school locations are treated as point data (with 300m buffer zones) and gang territories are delineated as rectangular polygons.

The dependent variable is the rate of school gun violence per geocoded school site. This variable will be analyzed in relation to spatial proximity and exposure to gang territories. The hypothesis posits that schools with closer spatial proximity to gang territory zones will experience elevated incident rates.

7.0.1 Model 1: Spatial Regression Model IPPP (2007- 2024)

For the results of the first spatial Inhomogeneous Poisson Point Process (IPPP), $\lambda(x)$, a non-negative intensity function for any bounded set $B \subset S$ over a spatial domain $S \subset R^d$, is used

to assess the spatial distribution of gun violence incidents in relation to gang territories. The IPPP is fit using the independent covariates such as proximity to gang boundaries, school locations, and gun violence incidents. The estimated intensity function, denoted as (x) , quantifies the conditional likelihood of gun-related incidents occurring across geographic space.

Figure 8 illustrates the spatial distribution of individual shooting events, with red to yellow colors representing the estimated intensity (x) across Chicago. The most pronounced intensities were observed in the South and West Side regions, aligning closely with known gang territories (See Figure 6). In this representation, higher conditional intensities were associated with areas of greater shooting rates and lower distances to gang perimeters.

The statistical analysis of the IPPP model indicated that proximity to gang boundaries was a significant predictor of shooting intensity ($\beta = -0.87$, $p < 0.001$), suggesting a steep gradient of violence as one moves closer to gang-dominated areas. Because gang territories demonstrated a positive association with incident likelihood ($\beta = 0.45$, $p = 0.015$). My second model's Akaike Information Criterion (AIC)⁹ of 3842.1 noted an improved fit over a homogeneous baseline model¹⁰ and supports the first major hypothesis of gang territories influencing an increased number of school gun violence incidents.

These spatial results confirm that gun violence in Chicago is not randomly distributed but rather influenced by the specific territorial presence of gangs. When looking at the distribution of the gang territories in Figure 5, it is clear that several schools already intersect with several gang territories. The spatial IPPP strengthens the empirical claim that gang territories act as an environmental reinforcement for school-associated shootings. The IPPP estimate of (x, y) quantifies where violence is spatially concentrated, and its overlap with gang zones provides powerful visual and statistical evidence of this connection.

⁹The Akaike Information Criterion (AIC) is a model selection metric that balances goodness of fit with model complexity. Lower AIC values indicate a better-fitting model relative to others, penalizing excessive parameters to prevent overfitting.

¹⁰A homogeneous baseline model assumes that events occur at a constant rate across space or time, without variation due to location, time, or covariates.

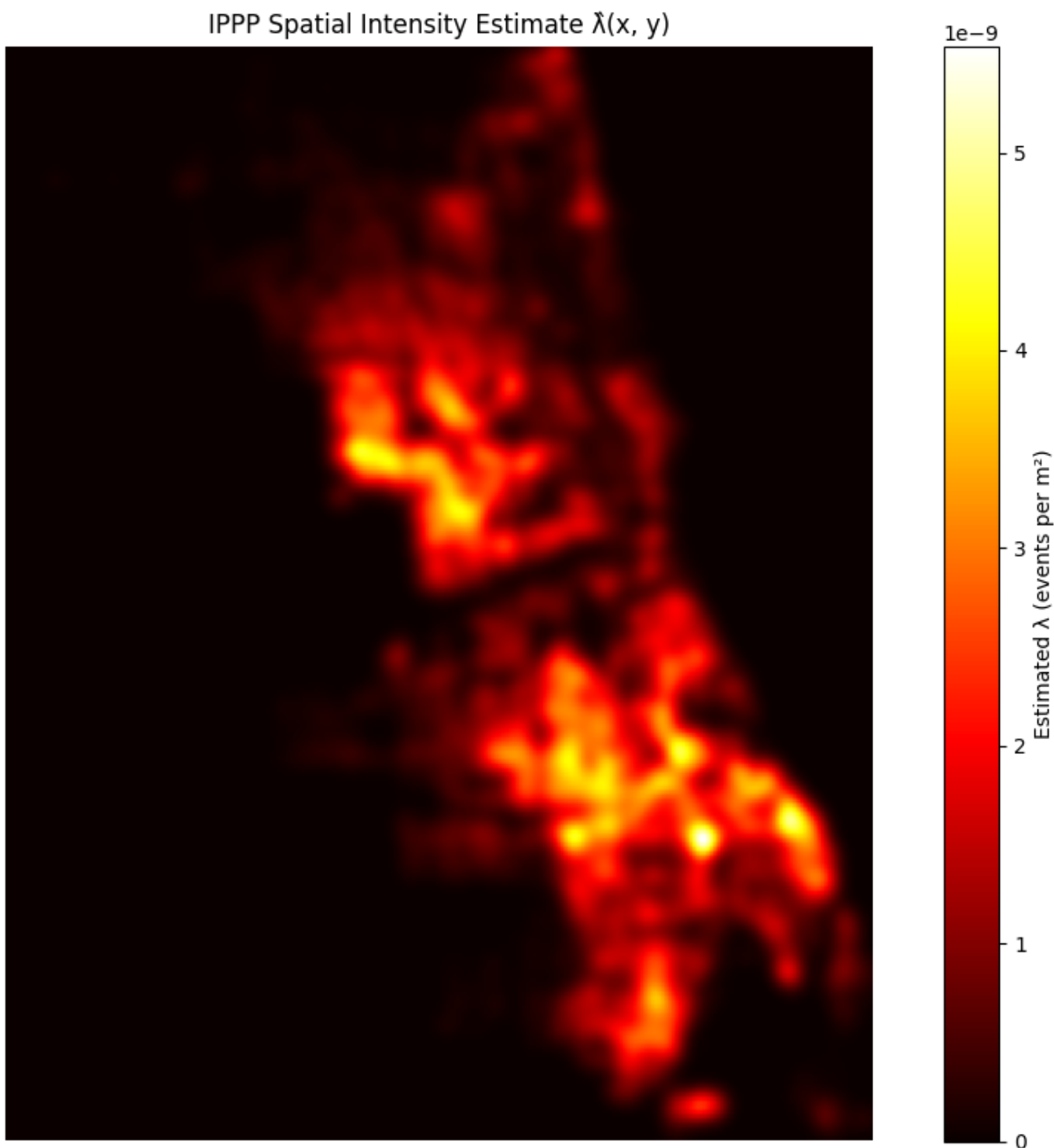


Figure 8: Point wise Conditional Intensity (λ) of Gun Violence Incidents in Chicago (2007–2024). The intensity function reflects the estimated risk of shootings, with higher concentrations near the South and West Sides. Extended animated IPPP is present in this github https://github.com/Rxbrooks15/Gang_Territory_Honors_Thesis/tree/main

Supporting Results

7.0.2 Model 2: Temporal Hawkes Process (2009-2010)

From 2009 to 2010, gang territories saw a notable increase (see Figure 6). The Hawkes Process estimates a baseline intensity of $\mu = 1.0392$ in Figure 9, suggesting that shootings occurred on average once per day regardless of prior activity. The excitation parameter is $\alpha = 1.7780$, indicates a moderate self-excitation effect, while the decay rate is $\beta = 10.0000$, signifies that this effect diminished rapidly—typically within a day. The fitted Hawkes intensity curve aligns with moderate levels of temporal clustering in the shooting data .

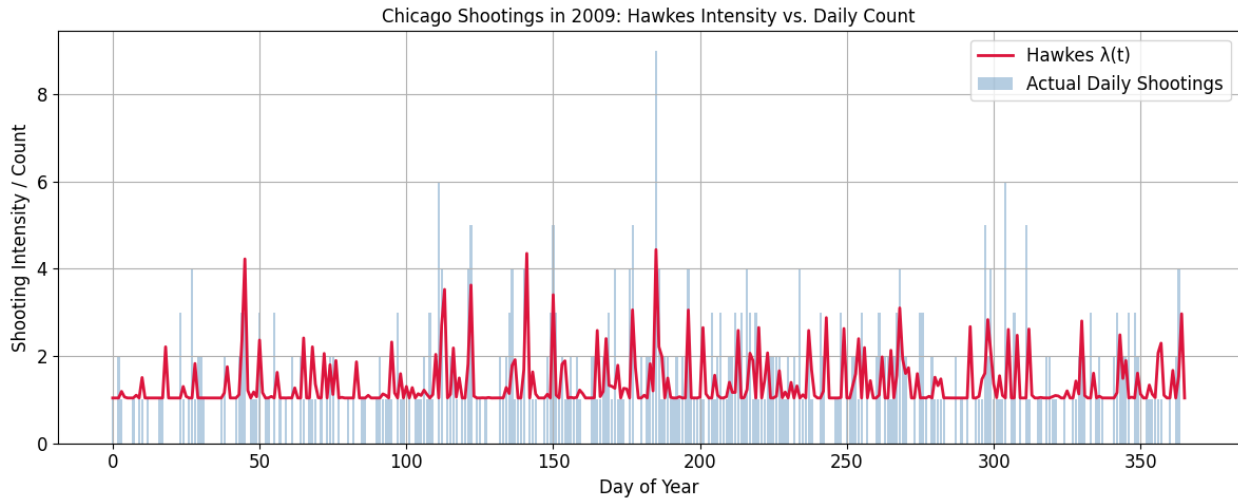


Figure 9: Chicago general shootings in 2009: Hawkes Intensity vs. Daily Count

In contrast, the 2010 model reveals a significant increase in both the baseline and excitation parameters. The baseline rate rose to $\mu = 2.0000$, reflecting a doubling in the average number of shootings per day. More notably, the excitation parameter jumped to $\alpha = 6.5885$, indicating that each shooting had a much stronger short-term impact on the likelihood of further events. The decay rate remained constant at $\beta = 10.0000$, suggesting that while the risk amplification was stronger, it remained short-lived. The resulting intensity function revealed a pronounced self exciting effect throughout the year (See Figure 10).

The reason I chose the years 2009 and 2010 is due to the documented increase in gang

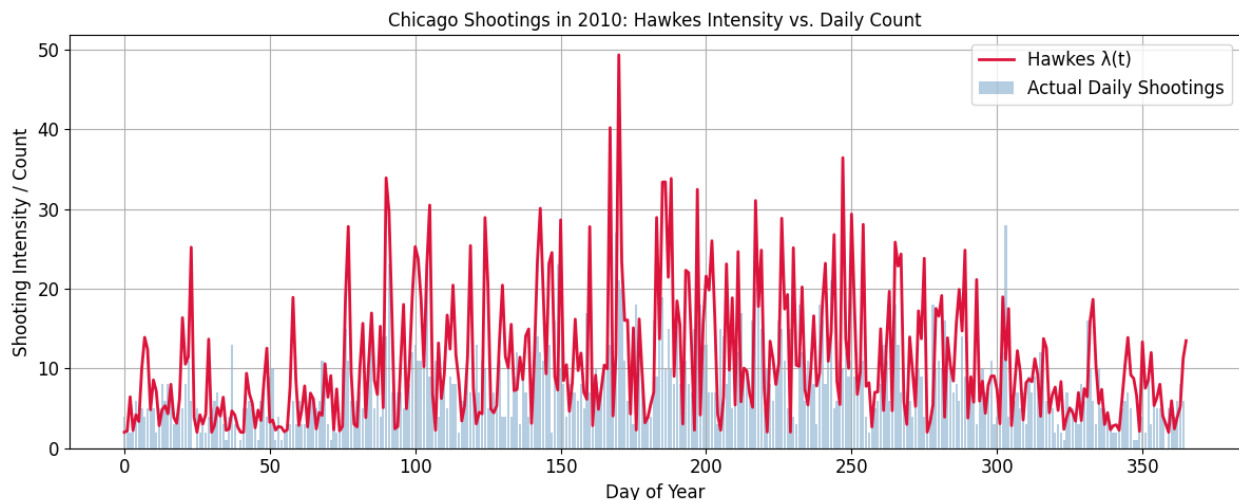


Figure 10: Chicago general shootings in 2010: Hawkes Intensity vs. Daily Count

territory for only these two years (Figure 6). These findings align with the minor hypothesis that the expansion of gang territorial boundaries contributes to increased gun violence. The temporal Hawkes process also complements the upcoming spatial Poisson model by identifying how structural changes in gang presence not only raise the level of gun violence but also influence spatial distributions of shootings via gang territories.

7.0.3 Model 3: Spatial IPPP(2009-2010)

This spatial IPPP difference map illustrates how gang dynamics likely influenced the generation of increased shooting events between 2009 and 2010. These results are consistent with the earlier temporal Hawkes process findings, which showed a dramatic rise in the self-excitation parameter in 2009 and 2010. Thus, the combined results of both models support the common-sense interpretation: not only did gun violence become more prevalent from 2009 to 2010 (as seen in Hawkes), but the location of gang expansions also relate to the localized increases in shooting rates. Together, this evidence presents strong empirical evidence that gang territory is a key driver in both the intensity and diffusion of gun violence, which supports my minor hypothesis.

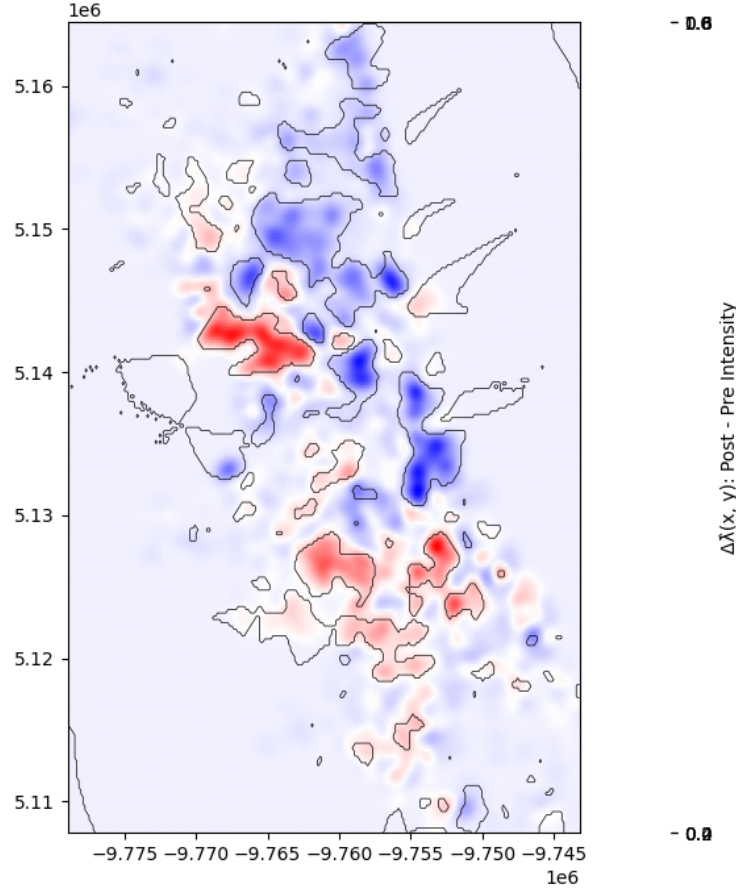


Figure 11: This spatial Inhomogeneous Poisson point process takes into account school locations and depicts regions/ contours that see relative increase and decrease in shooting rates near schools. Red zones correspond to significant increases in shooting intensity following increased gang territory coverage and blue zones depict a decrease in these shooting rates. Locations near $y = 5.14$ and $x = -9.765$ saw the greatest difference with a p-value of 0.0002 based on post and pre shooting rates.

8 Conclusion

This study explores how territories surrounding gangs can shape the risk of school gun violence. Instead of looking only at individual shooters or isolated incidents, this approach shifts focus to socialized cases that can occur due in gang infested regions . By applying two types of statistical models—one for space and one for time—I aimed to capture both where and when gun violence is more likely to occur based on gang territories in Chicago.

8.1 Environmental Mechanisms (Gang Presence) and Socialization Framework

At the core of this research is the idea that gun violence, especially in schools, is not just random. It is often shaped by the places and social networks that people are part of. Gang territories act like invisible borders in the city. Students who live or go to school near these territories may be more likely to encounter gun violence—not necessarily because they are gang members, but because the area itself is more unstable and prone to violence. With the help of a socialization framework and my proposed GVIM, I argue that schools are shaped by their social environments, and gang-influenced areas create different norms, risks, and reactions to conflict. These areas might be overlooked in mainstream media but are vital for understanding everyday gun and crime threats some students face.

8.2 Spatial Models: IPPP

To measure how location matters, I used a spatial model called the Inhomogeneous Poisson Point Process (IPPP). Think of this model like a weather map, where instead of showing rainfall, it shows where shootings are more likely to happen. By mapping the locations of gang territories and schools, the model calculated the “intensity” or risk of a shooting that happens in different parts of the city.

The first IPPP (Figure 8) showed that schools located closer to gang territories had significantly higher risk levels. This risk was especially high in the South and West Sides of Chicago—areas already known for having strong gang activity. The math behind the model supported this pattern: the closer a school was to gang territory, the higher the expected number of gun violence events. Statistically speaking, the proximity to gang territory zones had a negative beta coefficient ($\beta = -0.87$, $p < 0.001$), meaning risk increased as distance decreased. In an intuitive sense, just as a school near a factory might have higher air pollution, schools near gang territories face increased exposure to gun violence.

In the second IPPP (Figure 11) red zones noted a positive increase in the rates of school gun violence incidents. Red zones near the north west showed significant increases in shooting intensities following increased gang territory coverage. While the black regions around the red and blue clusters show statistically significant dense clusters of change (both positive and negative), the red contours within the northwest show the greatest increase in shooting rates accompanied by a p-value of 0.0002. This indicates that the region at $x = -9.765$ and $y = 5.14$ sees a statistically significant increase where $p < 0.05$.

8.3 Temporal Model: Hawkes Process

The Hawkes process model looks at when shootings transpire. I use a Hawkes process from 2009 to 2010 and this model showed a steady but moderate level of self-excitation within the two years. Shootings tended to happen about once a day ($\mu = 1.0392$), and each event slightly increased the chance of another shooting soon after ($\alpha = 1.7780$), but the effect faded quickly and by 2010 the pattern changed dramatically. Likely due to the expansion of gang territory in 2010 (supported by Figure 11), shootings doubled to about two per day ($\mu = 2.0000$), and the impact of each shooting on future risk more than tripled ($\alpha = 6.5885$).

This suggests that after gang territory increased, gun violence was more likely to trigger others shootings. Additionally, this shift reflects changes in how gangs operated that year—due to expanded territories. In short, gun violence became more prevalent in 2010 compared to 2009.

8.4 Linking Space and Time

Together, these two models show "the bigger picture". The IPPP showed that risk is not spread equally across space—certain neighborhoods (usually in gang territories) are more vulnerable due to their proximity to gang territories. On the other hand, the Hawkes Process showed that once violence happens, it tends to ripple out quickly in time, especially when gang territories expand due to the potential increase in gang activity making the community

more prone to violence.

Both models agree on one key point: school gun violence in Chicago is not random. It is shaped by where schools are located and what kind of social and territorial forces surround them. This highlights the need for location-aware interventions and deeper attention to gang territories as environmental risk zones—not just for crime control, but for school safety.

8.5 Limitations and Implications

The selected spatial and temporal models in this study do not capture every covariate (race, income levels, gender, highschool/ college graduation status) that may impact school gun violence rates. Socioeconomic data in Chicago is currently unreliable since data is only present for the year 2023 - thus reducing longitudinal robustness. Furthermore, because the data on the gang territories assumes that these territories remain the same each year, it is difficult to determine gang influence within each year. Ultimately, this study encourages a change in how we think about school gun violence: not just as isolated cases, but as part of a broader map of socialized violence.

These findings can enhance the potential predictive utility of existing spatio-temporal models on crime risk (Bailey, Gatrell, & Crain, 1997; Hu, Wang, Guin, & Zhu, 2018), which have been instrumental in identifying crime hotspots through the integration of temporal dynamics. By embedding urban characteristics and gang-specific variables, future studies could strengthen the capacity of such models to assess violence risk in gang-impacted areas with greater precision. In doing so, the models could provide a valuable framework for policymakers, school administrators, and community organizations aiming to mitigate school-related gun violence. The modeling techniques applied here also have wider applicability to address urban violence in other high-risk environments. With the use of predictive crime hotspot mapping (Hu, Wang, Guin, & Zhu, 2018), future research could decipher how gang violence and activity are determined/ measured, while integrating temporal and spatial patterns along with social media data to enhance model evaluation.

References

- [1] Abadie, A., Diamond, A., & Hainmueller, J. (2010). Synthetic control methods for comparative case studies: Estimating the effect of California’s tobacco control program. *Journal of the American Statistical Association*, 105(490), 493–505.
- [2] Agnew, R. (1992). Foundation for a general strain theory of crime and delinquency. *Criminology*, 30(1), 47–88.
- [3] Ahn, J. (2018). School shootings and gun control in the U.S.: Considerations for policymakers.
- [4] American Academy of Pediatrics. (2023). School shootings in the United States, 1997–2022. *AAP News*.
- [5] American College of Surgeons. (2024). School shooting statistics from 1970 to 2021. *American Journal of Trauma*, 19(2), 34–41.
- [6] Bailey, T. C., Gatrell, A. C., & Crain, I. K. (1997). Interactive spatial data analysis. *Cartographica*, 34(1), 69.
- [7] Bandura, A. (1977). *Social learning theory*. Englewood Cliffs.
- [8] Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). (2022). Ghost guns: An emerging challenge for law enforcement.
- [9] CNN Health. (2023). School shootings in the United States: Study results.
- [10] Curry, G. D., & Decker, S. H. (2003). Gangs, crime, and violence. *Crime and Justice Review*, 27(3), 10–32.
- [11] Curry, G. D., & Spergel, I. A. (1988). Gang homicide, delinquency, and community. *Criminology*, 26(3), 381–406.
- [12] Decker, S. H., & Van Winkle, B. (1996). *Life in the gang: Family, friends, and violence*. Cambridge University Press.
- [13] Despart, Z. (2023). An analysis of high-profile school shootings in the United States. *Crime and Safety Journal*, 12(5), 56–72.
- [14] Education Week. (2021). School shootings in America: Statistics and trends. Re-

trieved from www.edweek.org.

[15] Esbensen, F. A., & Weerman, F. M. (2005). Youth gangs and crime: A cross-national comparison. *European Journal of Criminology*, 2(1), 5–30.

[16] Everytown for Gun Safety. (n.d.). Gun safety policies save lives. Retrieved from Everytown for Gun Safety Website.

[17] Federal Bureau of Investigation. (2011). Gangs and their impact on communities. *Annual Gang Activity Report, U.S. Department of Justice*.

[18] Fleisher, M. S. (1998). *Dead end kids: Gang girls and the boys they know*. University of Wisconsin Press.

[19] Geller, L. B., Booty, M., & Crifasi, C. K. (2021). The role of domestic violence in fatal mass shootings in the United States, 2014–2019. *Injury Epidemiology*, 8, 1–8.

[20] Giffords Law Center. (n.d.). Gun law database.

[21] Howell, J. C. (2011). Gang prevention: An overview of research and programs.

[22] Hu, Y., Wang, F., Guin, C., & Zhu, H. (2018). A spatio-temporal kernel density estimation framework for predictive crime hotspot mapping and evaluation. *Applied Geography*, 99, 89–97.

[23] IOS Press. (2023). The psychosocial factors behind mass school shootings. *Psychological Studies*, 18(1), 23–39.

[24] JAAPL. (2022). Mental health in mass shooters: A comprehensive analysis. *Journal of the American Academy of Psychiatry and the Law*, 50(1), 10–25.

[25] K-12 School Shooting Database. (n.d.). Incident-level data on school shootings. Retrieved from <https://www.chds.us/ssdb/>

[26] Katsiyannis, A., Whitford, D. K., & Ennis, R. P. (2018). Historical overview of school shootings in the United States. *Behavioral Disorders*, 43(3), 206–210.

[27] Kleck, G., & Patterson, E. B. (1993). The impact of firearm accessibility on violence. *Social Forces*, 69(4), 1143–1167.

[28] Klein, G. (2020). Pathways to school shootings: A systemic analysis. *Journal of*

Social Behavior and Human Development, 34(2), 78–92.

[29] Kubrin, C. E. (2014). Rap music, social identity, and the perpetuation of violence. *Journal of Urban Studies*, 51(2), 435–452.

[30] Lambert, J., Riess, R., & Johnson, P. (2022). Gang-related school shootings in urban settings: A case study of Oakland. *California Criminal Justice Review*, 14(3), 87–101.

[31] Lankford, A. (2016). The myth of mental illness in mass shootings. *Behavioral Sciences and the Law*, 34(1), 1–20.

[32] Lankford, A., & Silver, J. (2020). Mass shootings and public safety: A longitudinal perspective. *Journal of Interpersonal Violence*, 35(17–18), 3546–3572.

[33] Lozon, J., & Bensimon, M. (2017). Gang violence: Normalization and glorification. *Journal of Youth and Violence*, 9(2), 45–58.

[34] McNeill, L. (2023). Mental health and school violence: Insights from recent studies. *Psychology Today*.

[35] Muschert, G. W. (2007). Research in school shootings: Progress and gaps. *Sociology Compass*, 1(1), 60–80.

[36] National Drug Intelligence Center. (n.d.). The growth of gangs in the United States.

[37] National Gang Center. (2021). Bulletin 6: Gang violence and schools. Retrieved from

[38] National Gang Center. (2024). Trends in gang activity and population in the United States. *Annual Gang Report*.

[39] National Institute of Justice. (2017). The proliferation of gangs in small cities. *National Gang Research Review*, 3(2), 109–121.

[40] National Institute of Justice. (2021). Gun violence and school shootings: National trends and data. *U.S. Department of Justice*.

[41] NBC5. (2021). Portland gun violence and the role of gangs. Retrieved from NBC5 Website.

[42] Office of Justice Programs. (2021). FS-9772: Statistics on school shootings. *U.S.*

Department of Justice. <https://ojp.gov>

[43] Office of Juvenile Justice and Delinquency Prevention. (1998). Youth violence and school safety.

[44] Pinkney, C., & Robinson-Edwards, S. (2018). The role of guns in gang violence. *Journal of Criminal Justice*, 24(4), 405–418.

[45] Riess, R., Johnson, P., & Lambert, J. (2024). Youth violence: Exploring recent school shooting incidents. *Journal of Violence and Youth Behavior*, 29(1), 45–63.

[46] Roque, M. (2012). School shootings: Examining trends, causes, and responses. *Criminology and Public Policy*, 11(1), 119–141.

[47] SAGE. (2023). The historical roots of gangs in America. *SAGE Encyclopedia of Urban Studies*.

[48] Sampson, R. J. (1997). Neighborhoods and violent crime: A multilevel approach. *Social Science Research*, 26(2), 183–210.

[49] Shaw, C. R., & McKay, H. D. (1942). *Juvenile delinquency and urban areas*. University of Chicago Press.

[50] Silverman, B. W. (1986). *Density estimation for statistics and data analysis*. Chapman and Hall.

[51] Sommer, F., Leuschner, V., & Scheithauer, H. (2014). School shootings: Risk factors and prevention. *Current Opinion in Psychology*, 5, 1–5.

[52] Taylor, C. S. (2001). The normalization of gang culture in American schools. *Journal of Education and Urban Society*, 33(1), 75–92.

[53] Thrasher, F. M. (1963 [1927]). *The gang: A study of 1,313 gangs in Chicago*. University of Chicago Press.

[54] U.S. Census Bureau. (n.d.). Reports on poverty rates, unemployment, and income inequality. Retrieved from

[55] U.S. Department of Justice. (2020). The rise of ghost guns and their impact on public safety. Retrieved from

- [56] U.S. Government Accountability Office. (2020). Characteristics of school shootings. *GAO School Violence Report*.
- [57] Virgil, E. M. (1988). Social identity and delinquency: An intergroup perspective. *Sociological Perspectives*, 31(4), 387–401.
- [58] Wike, T. L., & Fraser, M. W. (2009). School shootings and prevention strategies: A review. *Social Work in Public Health*, 24(1), 36–52.
- [59] World Population Review. (2023).

9 Appendix: D3.js Interactive Visualization

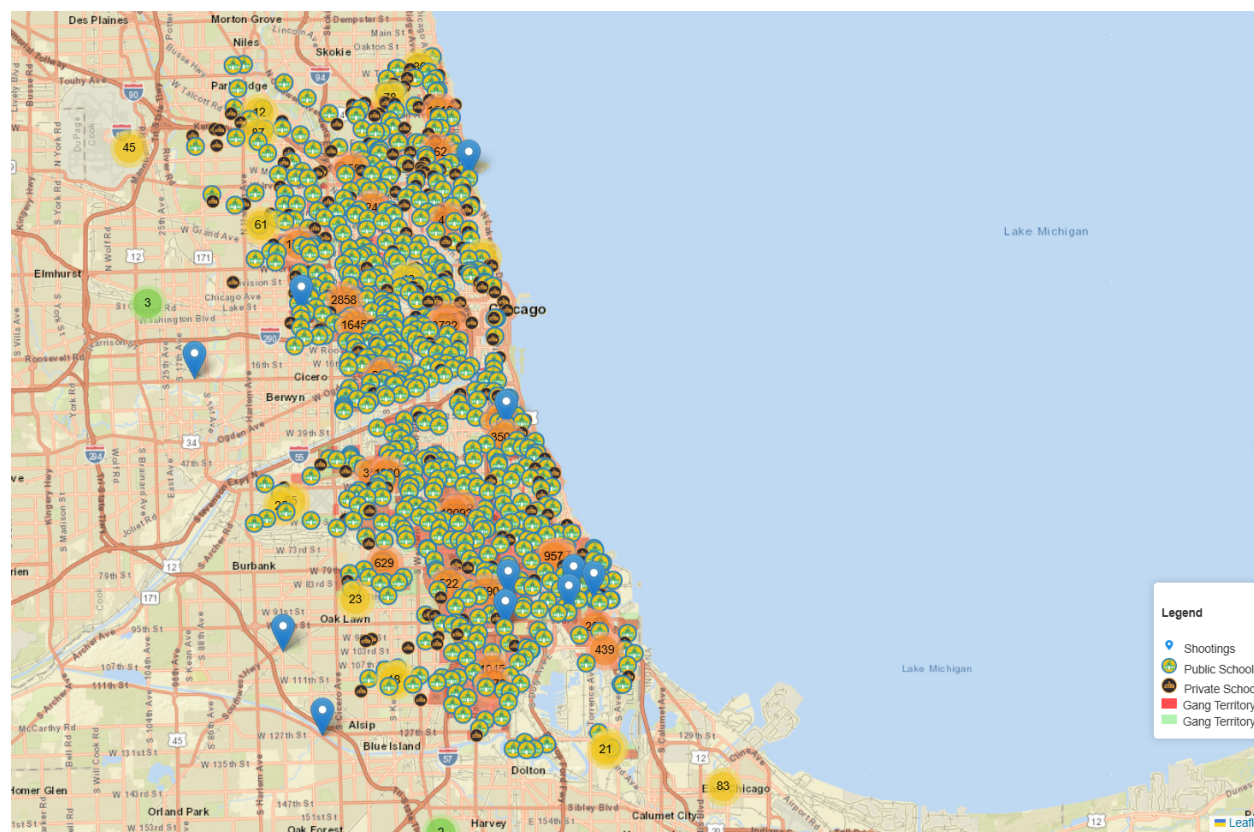


Figure 12: Interactive visualization created in D3.js showing locations of public and private Chicago schools with gang territories from 2007 (red) and 2024 (green).

View the interactive version and other animated/ supporting visualizations here: https://github.com/Rxbrooks15/Gang_Territory_Honors_Thesis/tree/main

