



Citizen Responses to Gunfire in St. Louis

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Citizen reporting to the police represents one of the most common pathways by which laws are enforced, yet many crimes go unreported. Less than half, about 45 percent, of violent victimizations are reported to the police (Truman & Morgan, 2016). The current study draws on a unique source of data, gunshots detected using an acoustic gunfire detection system (AGDS), to better understand patterns of reporting behavior. The goal of the study is to: 1) understand the prevalence of gunfire in communities and citizen responses to these incidents, particularly the willingness to call the police; 2) model variation in community reporting of gunfire to the police and contrast calls to police with gunfire detection data to determine when and where gunfire goes unreported; and, 3) document the role of community characteristics factors associated with the likelihood that gunfire incidents are reported to police.

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Citizen Reporting Behavior

The decision to report crime to police is the product of several individual and community factors. Crime reporting varies across communities, and even in high-crime areas, citizen reporting can be very low (Baumer, 2002). The individual decision to report crime to the police can be influenced by a number of factors, including citizen trust in the police. A citizen's decision to report a crime in their neighborhood demonstrates a commitment and bond between a resident and their community (Papp, Smith, Wareham, & Wu, 2019; Weitzer & Brunson, 2009). Willingness to report to the police can decrease when citizens are cynical or have less trust in the legal system, particularly when citizens believe that the justice system is unresponsive, incompetent, or illegitimate (Clampet-Lundquist, Carr, & Kefalas, 2015; Kirk & Matsuda, 2011).

Acoustic Gunfire Detection Systems

Acoustic gunfire detection systems (AGDS), like ShotSpotter, use technologies to detect and geolocate sounds believed to be gunfire. AGDS rely on arrays of microphones to detect and interpret sounds, searching specifically for those believed to represent the discharging of a firearm (Watkins, Mazerolle, Rogan, & Frank, 2002). By triangulating the sound waves detected by various microphones, the systems seek to geolocate gunfire. Alerts can be pushed directly to police communications personnel to coordinate appropriate responses by patrol officers. Most scientific tests attest to the reliability of the technology (Chacon-Rodriguez, Julian, Castro, Alvarado, & Hernandez, 2011).

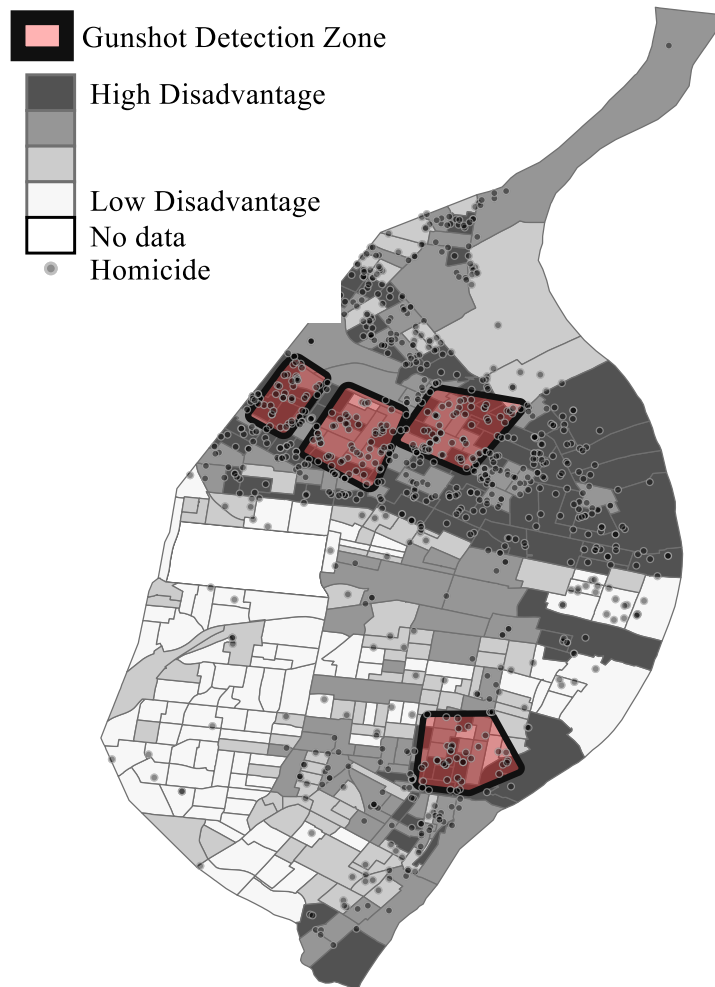
Study Site

This study focuses on the City of St. Louis, Missouri. The city is appropriate for several reasons. First, the city has higher rates of homicides and violent crime when compared to national rates. St. Louis had homicide rates of 49.9 and 59.2 per 100,000 population during 2014 and 2015, which increased to 67 homicides per 100,000 during 2017, over ten times that of the national average. In addition, the community is characterized by a deeply embedded gun culture (Huebner, Martin, Moule, Pyrooz, & Decker, 2016). Of the 926 homicides that occurred in St. Louis during 2014-2018, 94% were

committed with a gun, and there were more than 16,700 nonfatal incidents of gun violence during the study period.

The City of St. Louis implemented AGDS in 2010 and expanded its coverage to the current level of approximately 5.2 square miles in 2013 (about eight percent of the total 66 square miles of the city). An estimated 39,000 residents lived within the AGDS zones (see figure 1). The AGDS zones are centered in communities marked by high crime and disadvantage; however, there is substantial variation within these zones. Figure 1 provides a graphical representation of the communities within the AGDS zones in St. Louis. Communities in the AGDS zones have a higher percentage of Black residents, higher rates of poverty, and larger rates of violent crime than the rest of the city.

Figure 1. Spatial distribution of acoustic gunshot detection zones, homicides (2014-2018), and concentrated disadvantage in St. Louis, Missouri block groups (N=360).





Data & Measures

We use five-years of data, from 2014 to 2018, for the analysis. Data were primarily obtained from the St. Louis Metropolitan Police Department (SLMPD). The SLMPD's computer-assisted dispatch (CAD) system includes data for all crimes, 911 calls for service, and gunshot detections, including time and location information.

Dependent Variable

The study considers whether citizens call 911 for 'Shots Fired' or 'Shooting' when incidents of gunfire are detected by an AGDS.

Incident Characteristics

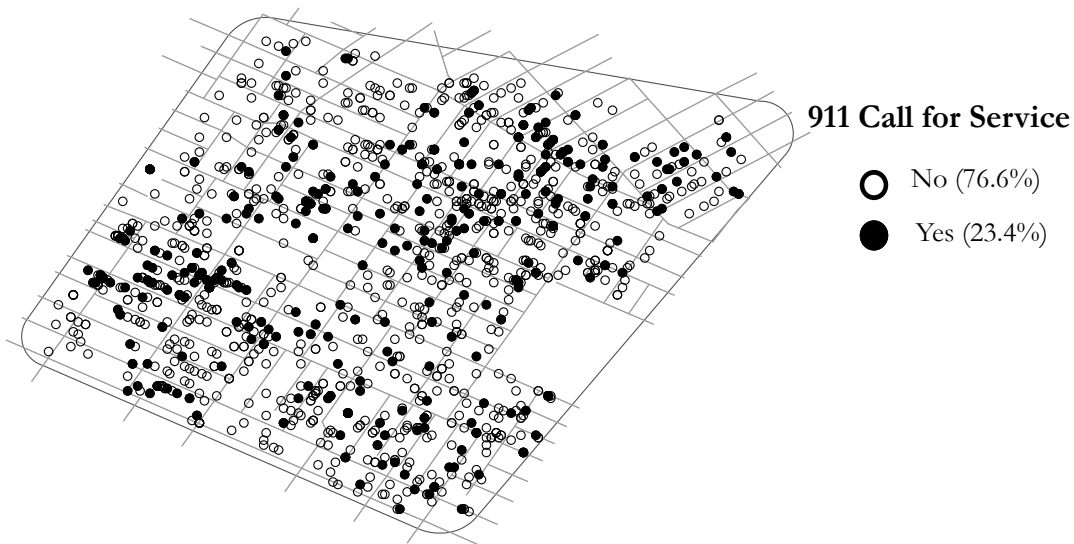
There is evidence that the nature of the incident, particularly the seriousness of the crime and nature of victim injuries, has substantial influence on third party reporting. We capture if the incident involved a *homicide*. We also measure several incident-level characteristics as temporal controls including the time of day (*nighttime*; between 6:00 PM and 6:00 AM) and day of the week (*weekday*; Monday through Friday).

Neighborhood Characteristics

We control for several neighborhood measures, Concentrated disadvantage combines percent in poverty, percent single female-headed households, and percent receiving public assistance into a standardized index of disadvantage (Sampson, Raudenbush, & Earls, 1997). We include a separate measure of percent Black. We also include a measure of 311 calls. The current analysis captures calls that pertained to reports of disorder (graffiti, dereliction, and public nuisance) and criminal or illegal behavior. Violent crime is measured as the average annual rate, between 2010 and 2014, of UCR Part I Violent crime incidents (homicide, rape, robbery, and aggravated assault) per 100,000 population. We include measures of population density and vacancy because the physical structure of a community has the potential to influence calling the police. Population density is the residential population divided by square mileage of the block group. Vacancy measures the percent of housing units that are vacant.

We estimated a series of multilevel regressions to examine the relationship between community characteristics and the likelihood that a 911 call for service will follow a gunfire event. There is a substantial amount of gunfire in AGDS zones and considerable variation in levels across communities. During the study period, there were 18,538 total gunfire incidents detected. There were 71 incidents of gunfire, on average, per week (10.2 per day) within the zones. Over the study period, 31.58 percent of the gunfire incidents detected by the AGDS also generated a 911 call for service from a citizen. Figure 2 provides a graphical display of the gunfire detected in one community to illustrate the preponderance of gunfire in these communities.

Figure 2. Example of N=1,356 Gunfire Incidents That Did/Did Not Generate a Call for Service During 2017 in One of the AGDS Zones (northeastern zone).



Incident-Level Effects

We consider the likelihood that a gunfire incident captured by the AGDS generated a 911 call for service. Gunfire incidents involving a homicide have 2.84 times higher odds of generating a 911 call. The likelihood of a gunfire incident generating a 911 call is higher during the nighttime and during weekdays (see Appendix A for more details).

Community Effects

We capture the effect of several community characteristics. Neighborhoods characterized by disadvantage, including high levels of poverty, single female-headed households, and residents eligible for public assistance, had lower rates of 911 calls. Conversely, communities that were more densely



populated had higher call rates. The racial composition of a community had some of the strongest effects on calls to the police, and the results document a strong, negative relationship. Majority Black neighborhoods were less likely, approximately 20%, to call 911 following a gunfire related incident. Finally, we consider the relationship between the 311-call and the violent crime rate on calls to the police. Communities with a high rate of 311 calls also had more calls to 911 for gunfire. In contrast, communities marked by higher crime rates had lower rates of calls to the police.

Discussion

Gun crime is a key public health issue, yet, much remains to be learned about the true nature and prevalence of this phenomenon (Wintemute, 2015). The incidence of gunfire is profoundly high in the city of St. Louis. This work highlights the potential efficacy of AGDS data to better study and address exposure to violence and other community stressors that are not available from other official records. The results suggest that there is substantial variation among neighborhoods in the likelihood that someone will call the police.

The study has important implications for research considering gun violence. In the St. Louis communities considered in this study, incidents of gunfire were reported to police less than one-third of the time. This outcome is similar to research by Carr and Doleac (Carr & Doleac, 2016), who found that only 12.4% of gunfire incidents in Washington, DC resulted in a call to police, and agrees with Hart and Miethe (2008) who contend that non-intervention is the norm in third party reporting situations. These results suggest citizen reports to the police might under-represent the actual prevalence of gunfire, at least in high gun-crime neighborhoods. The results from this research help build the case for a broader movement to collect diverse data on gun crime and highlight the need to better engage citizens to respond to shots fired incidents.

Policy

The results suggest three main considerations for policy. First, the low rate of reporting in relation to the prevalence of gunfire in high violence St. Louis neighborhoods suggests a need for greater trust and cooperation between police and the citizens. Greater community engagement might improve citizen reporting to the police. It is possible that what police need is not greater awareness of incidents of gunfire, but better information from citizens about such events to provide evidence and investigatory leads to support successful investigation and prosecution (Hipple, Thompson, Huebner, &



Magee, 2019). Increasing trust in the police has the potential to reduce violent retaliation. Research shows that gun crimes, and the highly interpersonal interactions that precede gun assaults, can result in a high risk for retaliatory violence (Cohen & Tita, 1999; Decker, 1996; Messner et al., 1999; Morenoff, Sampson, & Raudenbush, 2001; Rosenfeld, Bray, & Egley, 1999; Smith, Frazee, & Davison, 2000). Retaliatory violence can spill into surrounding neighborhoods (Decker, 1996; Papachristos, 2009; Tita & Griffiths, 2005) continuing the cycle of gun violence and the prevalence of gun assaults. Understanding the factors that facilitate and detract from citizen calling the police can help develop programming and policies that could potentially build trust and encourage victim reporting with the long-term goal of reducing crime. Given that minority communities have had a historically tenuous relationship with law enforcement (Gau & Brunson, 2010), these results suggest that many citizens may not have called the police because they do not trust the response or feel that the authority is illegitimate (White, Mulvey, & Dario, 2016).

As important, policing agencies should continue to break down and barriers to effective citizen communication. Community-oriented policing offers one potential intervention that has the potential to build community trust and enhance police legitimacy, which may increase citizen reporting. Community-oriented policing includes regular, positive contact between the police and public (Murphy, Mazerolle, & Bennett, 2014; Ren, Cao, Lovrich, & Gaffney, 2005). A recent study suggests that frequent, door-to-door visits, non-enforcement visits in a community can substantially increase positive perceptions of the police and citizen willingness to cooperate, and the effects were much stronger for persons of color (Peyton, Sierra-Arévalo, & Rand, 2019). Community-oriented policing provides one avenue of agency change that could have long-term effects on both crime incidence, citizen reporting, and general community satisfaction and engagement.

The low reporting rates may also reflect a lack of access to communication devices among the population. The US is marked by a digital divide in which impoverished communities have less access to consistent internet and other technological services (van Dijk, 2005). Individuals living in many metropolitan areas struggle to gain and maintain access to basic communication technologies, including mobile phones, and often experience cycles of dependence instability (Gonzales, 2016; Gonzales, Ems, & Suri, 2014). It may be that individuals in communities in more disadvantaged neighborhoods are less likely to call 311 or 911 because they have less access to phones or other technology that can be used to contact the authorities.

Finally, this research highlights the importance of developing interventions that address the inherent trauma for persons of color living in high-crime communities, especially in places like St. Louis, that have been marked by police violence and disorder (Boyd, Ellison, & Horn, 2016; Smith Lee & Robinson, 2019). Exposure to violence harms emotional health and physical well-being, particularly for



children. This study underscores the high levels of exposure to gunfire among some residents of St. Louis.



Appendix A

Multilevel Logistic Regression Models Explaining the Likelihood that a Gunfire Incident Generates a 911 Citizen Call for Service (N = 18,538).

Variable	Model 1	Model 2	Model 3	Model 4
Incident-level				
Homicide occurred	2.840	2.852	2.897*	2.923*
Nighttime (6PM-6AM)	1.310***	1.314***	1.313***	1.313***
Weekday	1.078*	1.076*	1.076*	1.077*
June	0.741***	0.740***	0.738***	0.739***
Year ¹				
2014	1.135	1.135	1.136	1.134
2015	1.403***	1.410***	1.414***	1.411***
2016	1.227***	1.227***	1.229***	1.228***
2017	1.149**	1.148**	1.150**	1.150**
Block Group (Standardized)				
Median Age		0.899*	0.973	0.987
Percent Vacant		0.958	0.994	0.978
Disadvantage		0.824***	0.929	0.963
Population Density		1.160*	1.105	1.092
% Black			0.804***	0.859**
311 Call Rate				1.116**
Violent Crime Rate				0.922*
Constant	0.309***	0.321***	0.307***	0.303***
Intraclass Correlation	0.050***	0.031***	0.019***	0.017***
AIC	22569.91	22550.78	22527.75	22524.54

NOTES: *p < .05; **p < .01; *** p < .001 (two-tailed). Coefficients presented as factor changes in odds ratio. Robust standard errors estimated (not shown).

¹ The reference category is 2018.



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