Shots Fired: Crime and Community Engagement with Law Enforcement after High-profile Acts of Police Violence

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Abstract

How does police violence affect civilian engagement with law-enforcement? We document a sharp rise in gunshots coupled with declining 911 call volume across thirteen major US cities in the aftermath of the murder of George Floyd. This pattern occurs in both white and non-white neighborhoods, is not driven by ceiling effects in crime reporting, persists beyond the protest movement, and is not accompanied by large declines in police response times. We find similar declines in reporting after the murder of Michael Brown, but not for other, less nationally salient police murders. Trends in national survey data reveal that police favorability also declined sharply after George Floyd's murder, and that victims of crime became less likely to report their victimization due to fear of police harassment. Our results suggest that high profile acts of police violence may erode a key input into effective public safety, civilian crime reporting, and highlight the call-to-shot ratio as a natural measure of community engagement with law-enforcement.

JEL classification: K4

Keywords: police, crime reporting, use of force, race

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In recent years, high-profile acts of police violence against unarmed Black individuals have sparked widespread allegations of racial discrimination and national calls for policing reform. Such events are not unique in American history, nor are their attendant concerns (Cunningham & Gillezeau, 2018, 2021). The 1968 Kerner Commission report attributed nationwide civil unrest to the belief in Black communities in "the existence of police brutality and a double standard of justice and protection." More generally, scholars have long argued that injustice within the legal system, and in particular police violence, may foster institutional distrust and legal cynicism or estrangement (Archibong & Obikili, 2020; Ba *et al.*, 2021; Bell, 2017; Kirk *et al.*, 2012; Sampson, 2012; Weitzer, 2002).

Central to these concerns is the understanding that civic trust and engagement is critical to many aspects of a well-functioning government. In particular, police departments are highly reliant on community cooperation and assistance to identify, report, and solve crimes. As former New York City police commissioner Bill Bratton stated, "police are most effective when they work in partnership with the community... when they are responding to citizens' needs and working with citizens on determining priorities" (Bratton, 1997). If use of force degrades citizen trust in the police, these events could have the perverse effect of reducing policing efficacy, increasing crime and ultimately threatening public safety.

However, research exploring the causal effects of police violence on civilian-police cooperation is scarce and finds little consensus (Lerman & Weaver, 2014; Desmond *et al.*, 2016; Zoorob, 2020; Cohen *et al.*, 2019; Desmond *et al.*, 2020).[1] Two studies examining 911 call patterns in Milwaukee after the 2005 police beating of Frank Jude come to conflicting conclusions, with one claiming decreased call volume from Black neighborhoods and the other finding no effect. A fundamental complication with criminal justice research in general, and this topic in particular, is that nearly all relevant outcomes are subject to selection bias. 911 calls represent the intersection of incidents observed in a community and that community's willingness to report those incidents to police. Thus, reductions in 911 calls could represent

[1] In related work, Jacome (2021) found that prioritizing violent offenders for immigration enforcement increased crime reporting among Hispanic communities in Dallas.

reduced engagement with the police or actual reductions in criminal incidents, two explanations with drastically different policy implications. In theory, benchmarking changes in 911 call volume to changes in actual crime could help to disentangle the competing narratives. In practice, researchers typically only observe crimes that have been reported to or directly witnessed by police, further compounding the issue.

To isolate changes in reporting from actual changes in crime, we pair 911 call volume with data on acoustically detected gunshots. The gunshot data come from a system of fixed-location microphones that cities across the nation have begun to install in order to detect and locate gunfire. While imperfect, the data provide a consistent proxy of local crime that is less reliant on human reporting than other measures. By combining this information with detailed data on 911 calls for service, we are able to observe, for a given gunshot, how likely a community is to call the police. Prior work has leveraged data from acoustic gunshot detection systems to explore how similar measurement issues related to selective reporting can complicate the interpretation of quasi-experimental research designs in the context of policy evaluation (Carr & Doleac, 2016, 2018). We build on this insight by offering the call-to-shot ratio as a measure of community engagement and cooperation with the police. As validation, we show that survey measures of perceptions of police are highly correlated with call-to-shot ratios in a city, but uncorrelated with total call volume.

Using our call-to-shot measure, we then explore how the civilian crime-reporting evolved in the aftermath of high-profile police acts of police violence. Examining data for thirteen major cities, we show a sharp drop in the ratio of 911 calls to acoustically detected gunshots immediately after George Floyd's death. While gunfire spiked following the killing and remained persistently high through the end of 2020, total calls-for-service volume declined. For the subset of 911 calls we are able to identify as specifically relating to gunshots, we observe a short-run (4-week) increase during the post-killing protest movement followed by a rapid decline. Using either measure of 911 call volume, the net result is a nearly 50% reduction in crime reporting. Notably, this drop is reflected across nearly all sample cities and persists

until the end of 2020. We find similar patterns in majority-Black, majority-Hispanic and majority-white neighborhoods.

Importantly, the reporting patterns hold across a range of robustness checks meant to rule out competing theories and concerns. We show that declines are similar in neighborhoods that had high and low reporting rates at baseline suggesting that the drop in the call-to-shot ratio is not the product of a "ceiling" effect on communities willingness to report gunfire. We also find that little evidence of increased police response times suggesting that de-policing in response to protests is unlikely to explain the main effects. To further corroborate the role of changing civilian behavior, we show robustness to excluding those 911 calls that are most likely to be initiated by police. We also find similar effects when benchmarking 911 calls to gun violence casualties and automated alarms indicating that effects are not driven by measurement error in the acoustic gunshot detection data. Finally, we demonstrate robustness to controls accounting for seasonality trends in 911 calls, pandemic-induced changes in community mobility, and numerous other factors.

To further interrogate the role of declining trust in law enforcement in explaining decreased crime reporting, we leverage detailed data from the National Crime Victimization Survey. Comparing observably similar incidents, we find that individuals victimized after George Floyd's murder were significantly more likely to report mistrust of law enforcement and fear of police harassment as the main reasons they chose not to report the incident to police. We find little evidence of reporting changes due to other reasons (e.g. private concerns). Taken together, these patterns suggest that the declines in crime reporting are connected to a broader decline in institutional trust over this period.

We conclude by pivoting to two complementary questions raised by the declines in reporting that emerged in the wake of the murder of George Floyd. First, we ask if the patterns we document after the murder of George Floyd are unique to the particular cultural moment, or extrapolate to other acts of police violence. Examining a sub-sample of cities with historical data, we find large declines in the call-to-shot ratio after the murder of Michael Brown.

However, we find little evidence of similar shifts following police murders garnering less public attention, suggesting salience as an important mediator. Second, we ask whether civilian engagement can be rebuilt after the conviction of the officers involved in police brutality. To do so, we extend our sample to examine trends through April 21, 2021, when Minneapolis police officer Derek Chauvin was found guilty of murdering George Floyd. Notably, we find little evidence that civilian reporting converges to pre-Floyd rates even after the Chauvin conviction. Together, our results point to the lasting damage that police violence may have on civilian cooperation and engagement with law enforcement.

1 Police favorability in the wake of George Floyd's murder

The murder of George Floyd was just one of a string of recent police killings of unarmed Black individuals. Every year, roughly a thousand people die at the hands of American law enforcement officers. Estimates suggest that more than half of these individuals were racial minorities and that roughly 40% did not possess a gun (Washington Post, 2021). While the vast majority of these incidents received little public attention and studies have shown that the social impacts of police killings are often highly geographically-localized (Ang & Tebes, 2020; Ang, 2021), viral footage of Floyd's death spread rapidly across social and traditional media platforms, sparking nationwide protests and renewed debate about racial bias in policing. Thus, while the incident bears many similarities to other recent incidents, its high visibility allows us to interrogate the impact of police violence on civilian engagement, even among communities with little direct exposure to those types of events.

[Figure I about here.]

Figure I tracks trends in public perceptions of police before and after the killing of George Floyd. The data come from Nationscape and includes a nationally representative sample of 6,250 weekly interviews from January to July 2020. We find a sharp decrease (increase) in the share of respondents holding favorable (unfavorable) views of police after George Floyd's

death. Notably, this is true across racial groups, with similar patterns for white and Asian individuals, those groups who are least likely to be killed by law enforcement, as for Black and Hispanic individuals, those groups who are most likely to experience police violence.

Floyd's killing merits particular focus for another reason. Derek Chauvin, the Minneapolis police officer who knelt on Floyd's neck, was convicted of murder in a verdict seen on live television by over 23 million Americans. It is incredibly rare that police officers are charged, much less convicted, even after high-profile use of force incidents. For example, Darren Wilson was not indicted for killing Michael Brown in Ferguson, nor was Daniel Pantaleo charged for killing Eric Garner in New York. Of the roughly 15,000 fatal police killings that have occurred since 2005, only 140 officers were arrested for murder or manslaughter and of those, fewer than 50 were ultimately found guilty (Stinson, 2019). President Biden hailed the conviction as a "giant step forward in the march toward justice in America," while the Floyd family attorney called it a "turning point in American history for accountability of law enforcement." Thus, the verdict presents a rare opportunity to assess whether highly-salient examples of officer discipline can repair civilian trust and reporting.

2 Background and data

2.1 Gunshots

Acoustic gunshot detection technology works via an audio recording system designed to capture the time and location of gunshots fired in an area. It is a common tool in a recent movement towards technology-supported policing, and has been implemented in more than 100 cities nationwide. The technology relies on a dispersed set of permanently-mounted sensors located on buildings across a city. When a shot is fired, the sensors triangulate its location using Geographic Information System (GIS) technology and send a notification to the local police department with the predicted location of the shot.

Acoustic gunshot detection technology is not without controversy. While proponents claim

the system can detect even silenced gunfire, there are concerns that it may also falsely classify car backfires, helicopters and fireworks as gunshots (Carr & Doleac, 2016). Community activists have further questioned how acoustic gunshot detection systems are used, arguing that its alerts may prime officers to incorrectly assume that suspects are armed and that the parent company's close relationship with police compromises its integrity (Stanley, 2021). However, evaluations suggest that the technology is generally accurate in detecting gunfire: acoustic gunshot detection technology is able to detect 80 to 99.6% of gunshots and to triangulate 91% of detected shots to within 40 feet of the actual location (Goode, 2012; Mazerolle *et al.*, 2000; Irvin-Erickson *et al.*, 2017; Watkins *et al.*, 2002).

Thus, while acoustic gunshot detection reports may include both false positives and false negatives, the data may nonetheless improve our ability to measure changes in violent crime when compared to traditional sources of crime micro-data, all of which rely on human reporting. The relative benefits of acoustic gunshot detection data are especially pronounced in our context. While both community and police reporting may be influenced by public scandals like high-profile police killings (Ba & Rivera, 2019), any measurement error in acoustic gunshot detection data is unlikely to be correlated with the timing of George Floyd's murder or the resolution of Derek Chauvin's trial. As corroboration, we show robustness using data on actual gun violence deaths and injuries, which are also unlikely to suffer from the reporting biases affecting lower-level offenses (Addington, 2008).[2]

2.2 Civilian Crime Reporting

To construct our measure of civilian crime reporting, we combine acoustic gunshot data with data on citizen-initiated 911 calls for service that have been routed to police departments. These calls are connected to local dispatch centers, which log the date and location of the call as well as details about the incident being reported. Importantly, our restriction to calls

[2]Data on the date and location of gun violence casualties come from the gunviolencearchive.org, which compiles information from over 7,500 law enforcement, media, government and commercial sources. While the data on acoustically detected gunshots and actual gun violence casualties are highly correlated, they are not 1-to-1 (see appendix figure A.I). The fact that we find similar patterns using either measure is thus reassuring.

that have been routed to police departments ensures that the data are capturing civilian crime reporting and not reporting related to other types of emergencies.

Our primary sample includes the thirteen cities where we were able to obtain both incident-level acoustic gunshot data and call-level data for 911 calls routed to police for the 2020 calendar year: Baltimore, MD; Cincinnati, OH; Fresno, CA; Glendale, AZ; Washington (DC); Miami, FL; Milwaukee, WI; Minneapolis, MN; New York City, NY; Oakland, CA; Richmond, CA; San Diego, CA; and San Francisco, CA. Together, these cities include major metropolitan areas across the East Coast, West Coast and Midwest encompassing over 15 million residents.

To minimize measurement error in the acoustic gunshot detection data caused by fireworks, we exclude data from New Year's Eve, New Year's Day and the Fourth of July. As acoustic gunshot detectors only cover parts of a city, we also restrict the sample to 911 calls initiated from neighborhoods in the local coverage areas.[3] The final sample contains 12.1 million 911 calls and 55,523 detected shots in 2020.

Because the categorization of calls into crime types differs widely across cities, our preferred outcome is defined as the ratio of total 911 calls to acoustically detected shots in an area-period. However, in robustness analysis, we show similar patterns when examining the ratio of "shots fired"-related calls to gunshots.

2.3 Correlation with Police Trust

To validate the call-to-shot ratio as a measure of police trust, Panel A of Figure II plots call-to-shot ratios in each city against the share of local Nationscape respondents reporting unfavorable views of police.[4] We find a significant, negative relationship between police trust and call-to-shot ratios. Cities with high shares of unfavorable views of police tend to receive

[3]Specifically, we examine only 911 calls that are located in Census tracts with at least one acoustically detected gunshot over the sample period.

[4]City call-to-shot ratios and police unfavorability rankings are based on data from January 2, 2020 to March 12, 2020, the day before the Covid-19 National Emergency. As the Nationscape data are identified by respondent Congressional District, we construct city-level police favorability measures by averaging across respondents in districts containing each city. We exclude small cities (i.e., Glendale, Arizona and Richmond, California) that comprise only a small share of any given congressional district, as responses are unlikely to be representative of views in those areas. However, results are robust to their inclusion.

fewer 911 calls per shot than cities with low shares of unfavorable police views. In contrast, we find little relationship between police favorability and 911 call volume. As shown in Panel B, views of police in a city are virtually uncorrelated with the average number of 911 calls made by its resident.[5]

[Figure II about here.]

Together, the results highlight the limitations of using raw 911 call volume as a proxy of community engagement and trust in police, while corroborating the importance of instead benchmarking 911 calls to local crime. Given the scarcity of granular survey data tracking public perceptions of law enforcement, the call-to-shot ratio may fill an important gap for researchers by serving as a "revealed preference" measure of police trust.[6]

3 Results

3.1 National Trends

To investigate how civilian crime reporting responded to the police killing of George Floyd, Figure III plots the ratio of weekly 911 calls to weekly gunshots over time. Both the numerator and denominator are aggregated across all sample cities. Panels A and B present results restricted to the set of 911 calls that we were able to manually identify as relating to gunfire. Panels C and D presents results where the measure of crime reporting includes all calls-for-service that were routed to the police.

[Figure III about here.]

[5]Similar patterns hold over time within cities. Regressing our 911 measures in a city-week on contemporaneous police trust and city fixed effects, we find that a one standard-deviation increase in police unfavorability predicts a 0.05 standard deviation reduction in local call-to-shot ratio (p-value = 0.044) but little change in local call volume (β=0.014, p-value = 0.659).

[6]Case in point, the Nationscape poll is the only public data source of police perceptions we found that spanned the murder of George Floyd and that included enough temporal and geographic granularity to conduct rigorous empirical research. Even there, the question on police perceptions was removed from the survey during the summer of 2020.

Panel A shows that the trend in gunshot reporting is relatively flat from the beginning of the calendar year and through the onset of the pandemic, with a sharp drop occurring immediately after the murder. Panel B reveals that this pattern is driven by surging gun-violence, which more than doubles in the weeks after George Floyd's death and remains over 70% higher than baseline through the conclusion of 2020.

The changes in gunshot reporting over time reveal a more complicated pattern. Initially, we see a sharp rise in those 911 calls that we are able to manually identify as relating to gunfire. However, this rise is followed by a similarly sharp decline precisely timed with the ending of riots and the national protest movement (see appendix figure A.V). The net result is that gunshot reporting dropped by over 30% and remained depressed through the end of 2020.

It is important to note that the data on 911 calls specifically relating to "shots fired" are limited in two important ways. First, we had to manually construct a flag for "shots fired" in our calls-for-service data using the text of incident descriptions as inputted by the 911 call center operators. Thus it is possible that this flag contains consequential forms of measurement error driven by the manner in which 911 operators recorded these descriptions.

Second, we note that our ideal measure of civilian engagement and cooperation would be the ratio of *all* reported crimes to *all* actual crimes; not just gunshots. Thus the measure that only uses calls for service related to gunfire could misstate the true impact of Floyd's murder by masking changes in reporting for other, less consequential crimes.

For these reasons, our preferred measure of civilian reporting is the ratio of all calls for service to all gunshots detected. This measure directly addresses the first limitation: since it does not rely on the incident descriptions, it cannot be affected by changes in the way that 911 operators input this field. Our preferred measure also addresses the second limitation. Since the numerator contains all crime reports, it is closer conceptually to the ideal ratio of all reports to all crime that we would like to observe.

We find similarly large declines in reporting using the "all calls" ratio. As shown in Panel

C, trends in call rates are relatively flat from the beginning of the calendar year until George Floyd's murder, with the exception of a level shift downward when the national COVID-19 emergency was declared on March 13, 2020. The primary difference between the patterns observed using the "Shots Fired" measure and our preferred measure using all calls is that total calls for service exhibits a drop. While calls were trending up to pre-pandemic levels in the weeks before Floyd's death, they decrease by nearly 25% in the weeks after and largely remained depressed for the rest of the year. This is consistent with an explicit reduction in the tendency of individuals to reach out to police. That aggregate calls actually fell despite increased gunfire provides further corroboration that civilian engagement and cooperation with law enforcement was eroded after the murder of George Floyd.

3.2 Robustness

Ceiling effects in crime reporting

One concern with our preferred interpretation of the data is that the changes could be driven by "ceiling" effects on reporting. Perhaps gunshots are surging in neighborhoods that never reported crime to begin with? In that case, we would see a decline in the call to shot ratio even though the underlying tendency to engage with the police did not change.

To address this, we split our sample according to baseline crime reporting rates. Appendix figure A.VI plots the call-to-shot ratio separately for census tracts that had above and below median reporting rates in 2019. We find similar declines, on the order of 50%, in both cases. Thus our results do not appear to be a product of ceiling effects in crime reporting.

De-policing and the "Ferguson" effect

Next we explore the possibility that the results are driven by de-policing. The literature exploring the existence of a "Ferguson Effect," in which public scrutiny of police brutality leads to reduced law enforcement effort and increased crime, has found mixed results (Prendergast, 2001; Shi, 2008; Pyrooz *et al.*, 2016; Wolfe & Nix, 2016; Owens, 2019; Devi & Fryer Jr, 2020).

Is it possible that the murder of George Floyd caused police to exert less effort, and that this is responsible for both the surge in gun violence and stagnating reporting?

We address this possibility in two ways. First, we note that the depolicing mechanism is consistent with the headline conclusion of the paper. If the murder of George Floyd caused protests that led to de-policing which reduced civilian engagement, then we would argue that this is still an important phenomenon to document and describe. However, distinguishing between a de-policing mechanism and a mechanism whereby police violence directly reduces cooperation and engagement irrespective of police effort is important for understanding the set of policies that have the potential to repair the damage.[7]

Second, and most importantly, we note that our data permit us to explore the de-policing hypothesis directly. For three cities in our sample, the 911 data also contains police response times related to the indicated call for service. If de-policing was responsible for the surging gun violence, we would expect to see a large increase in response times increase in the wake of the murder. Appendix figure A.VII plots police response times. The average police response time to a reported gunshot in the 72 days prior to Floyd's murder was 3.9 minutes; in the 72 days after the killing it was 4.9 minutes.

Fireworks and other sources of mis-measurement

As has been well documented in the press, there was a reputed increase in fireworks during the summer of 2020.[8] Thus, it is possible that the surge in acoustically detected gunshots is confounded by an increase in use of fireworks (or other sources of gunshot-like noise) after the murder of George Floyd.

We investigate this possibility in two ways. First, we note that the most obvious sources of mis-measurement, such as the protest movement and the purported surge in fireworks,

[7] If the de-policing mechanism is at work, then any policy which increases police effort could have the intended effect; however, if the direct channel is at work, perhaps working through an overall decline in trust in the police as an institution, then this would suggest that more systemic reforms are necessary.

[8] For example, see: https://www.theatlantic.com/technology/archive/2020/06/firework-summer-2020-conspiracy-theory-police/613450/

took place during the Spring and Summer of 2020. For that reason, explanations based on fireworks or other sources of gunshot-like noise will have trouble fitting the fact that the call-to-shot ratio continued to remain depressed well into the Fall and Winter of 2020. Second, in Appendix figure A.VIII, we show that similar patterns hold when benchmarking 911 calls to data on actual gun violence casualties, which are unlikely to suffer from the same sources of measurement error as the acoustically detected gunshots.

Next we note that while acoustically detected gunshots provide a measure of local crime that is not reliant on civilian or police reporting, this data will not capture changes in crime that are uncorrelated with gunshots. To address this concern, we identify calls for service triggered by automated alarms - such as silent bank alarms, home alarms and commercial alarms. As these incidents are also captured without an individual having to call police, they provide a proxy for property crime that is not mediated by human reporting. We replicate our primary analysis by charting 911 call volumes against the sum of acoustically detected gunshots and automatic alarms. These results are shown in Appendix figure A.IX and again reveal a sharp drop in civilian engagement after Floyd's murder.

Average effects and regression adjustment

In this section, we explore our key finding using simple regression models. This exercise is useful because it summarises the key results displayed in the figures into average effects. It also allows us to further explore robustness by adding controls and adjusting the functional form of the dependent variable.

Table I displays the results. The sample included in these regressions spans the 73 days between the COVID-19 National Emergency on March 13, 2020 and George Floyd's murder on May 25, 2020 plus the 73 afterwards. Panels A and B present results for the all calls-to-shots ratio in levels and in logs. Panels C and D present results for the all calls-to-gun violence casualty ratio in levels and in logs. Column (1) is our baseline model. Column (2) controls for a time trend. Columns (3) and (4) control for once and twice lagged dependent variables,

respectively. Column (5) includes controls for the amount of time spent in places of residence based on Google tracking data. Column (6) includes controls for total 911 call volume as measured on the same date in 2019. Column (7) includes all controls simultaneously.

[Table I about here.]

In all cases, we find that the period after George Floyd's murder had substantially lower crime reporting than the period prior, with estimates ranging from a decline of 0.88 to 0.45 log points. Thus table I shows that the key findings on display in figure III are not sensitive to alternative modelling choices.

3.3 Heterogeneity

Neighborhood Racial Composition

Though researchers disagree on whether officers discriminate in the use of force,[9] Black and Hispanic individuals are far more likely than other groups to experience police violence and to believe that it is an important public issue (AP-NORC, 2015; Edwards *et al.*, 2019). In contrast, rates of civilian-initiated contact with police—such as reporting a crime or approaching the police to seek help for a medical emergency—are highest among white individuals (Davis *et al.*, 2018). Thus, we next explore how the effects of George Floyd's murder on civilian crime reporting differed across racial groups.

To do so, we geo-code the 911 and gunshot microdata to Census tracts, which we merge with 2015-2019 American Community Survey data to obtain area demographics. We then calculate call-to-shot rates specific to each tract by, for example, dividing the total number of 911 calls in majority-Black tracts by the total number of gunshots detected in those same areas.

[Figure IV about here.]

[9]For example, see Cesario *et al.* (2019); Knox *et al.* (2020); Hoekstra & Sloan (2020); Lieberman (2020); Ba *et al.* (2021).

Figure IV plots changes in weekly call rates by neighborhood racial composition, normalized to call rates the week prior to Floyd's killing. While trends in Asian American call rates are noisy due to the scarcity of majority-Asian-American neighborhoods, we find large dips in calls per shot in majority-white, majority-Black and majority-Hispanic areas. Notably, the relative decrease in white call rates is as large, if not larger, than that in Black and Hispanic neighborhoods.

These results stand in contrast to prior research showing that the educational and voting effects of police violence are driven entirely by Black and Hispanic communities (Legewie & Fagan, 2019; Ang, 2021; Ang & Tebes, 2020). Instead, we find that George Floyd's death significantly reduced crime reporting across a wide range of communities, even those with the highest existing trust and engagement with law enforcement. This is consistent with the trends in police favorability examined earlier as well as broader discussions about the racial reckoning that viral footage of George Floyd's murder sparked among many white Americans.

City-level variation

Appendix figure A.II disaggregates the trends by city. We focus on the period after the national COVID-19 emergency declaration and plot deviations in call-to-shot ratios, relative to each city's call ratio during the week before George Floyd's murder.

We find a pronounced drop in call rates immediately following the incident date in nearly all cities. In Baltimore, Cincinnati, DC, Milwaukee, New York and Richmond, call rates drop nearly 50% in the weeks after George Floyd's death. The one case where trends are least clear, San Diego, is likely due in part to the city's small acoustic gunshot detection coverage area, which introduces noise in the denominator (ex: 15% of weeks had 0 or 1 detected shots).

The fact that the effect emerges in cities across the country highlights the broader civic ramifications of Floyd's killing. While law enforcement agencies are locally-governed institutions, our findings suggest that citizens may view them as part of a larger criminal justice system. As a result, highly visible acts of police violence, like George Floyd's murder in Min-

neapolis, may fuel disengagement with local law enforcement agencies even among residents living in geographically and politically disparate areas.

3.4 Trust in Police as a Mechanism

Given the declines in reporting documented in figure III and the similarly large declines in police favorability documented in figure I, a natural follow-up question is the extent to which the two patterns are connected. Are declines in reporting after high profile acts of police violence driven by damage done to trust in law enforcement as an institution?

To explore this, we turn to data from the National Crime Victimization Survey (NCVS). NCVS is a large-scale national survey conducted by the Bureau of Justice Statistics. Throughout each year, roughly 160,000 households are interviewed about the frequency and nature of crime victimization incidents experienced in the past six months. Importantly, respondents are asked not only whether they reported a victimization to police but also the reason they did or did not report the incident. As the survey includes information on the month of each incident, this data allows us to explore the potential role of changing perceptions of the police as a mediator for non-reporting following George Floyd's murder.

[Table II about here.]

In Table II, we examine all NCVS incidents from January 2019 to August 2021 and estimate the change in non-reporting before and after May 2020, accounting for seasonality patterns through calendar month fixed effects. In Panel A, our outcome is an indicator set to 1 for incidents that were unreported due to police mistrust.[10] Column 1 reveals that respondents who were victimized after the murder of George Floyd were significantly more likely to decide not to report due to concerns about police, relative to respondents victimized before Floyd's murder. Point estimates suggest nearly a 20% increase in non-reporting due to mistrust, roughly 1.5 fewer reports per 100 incidents. Notably, estimates are virtually unchanged

[10]Specifically, incidents for which the "most important reason" for non-reporting was the belief that "police wouldn't think it was important enough", "police would be inefficient, ineffective" or "police would be biased, would harass/insult respondent, cause respondent trouble, etc."

when including additional controls for victim and incident characteristics (Columns 2 and 3), suggesting that changing selection into the NCVS sample is unlikely to explain our findings.

Meanwhile, in Panel B, we show no effect on crime non-reporting due to the two most commonly-stated reasons in the NCVS (i.e. the belief that the incident was a private or minor concern). Point estimates are near zero across specifications. Like all survey data, the NCVS data may be subject to selective recall and inaccurate reporting. However, the results are consistent with our core call-to-shot ratio findings and suggest that actual crime victims were less likely to report incidents to police due to institutional mistrust following the murder of George Floyd.

4 Discussion

The decline in community engagement engendered by the murder of George Floyd raises a number of important, secondary questions. While it is outside the scope of this paper to provide definitive answers to all of them, they are worth discussing in more detail.

4.1 Will these results generalize to other acts of police violence?

The murder of George Floyd was a highly salient act of police violence that occurred during a global pandemic and hyper-polarized election year. In this context, it is possible that the stark findings documented here are a product of the particular cultural moment that surrounded George Floyd's murder. Thus, we attempt to explore the external validity of our results in two ways.

First, and most importantly, for two cities in our sample, we are able to construct call-to-shot ratios around the 2014 police killing of Michael Brown, the most nationally salient act of police violence prior to George Floyd's murder. Figure V displays these results. As with the George Floyd murder, we document a striking decline in civilian crime reporting coinciding with the date of the incident. This suggests that our results may generalize to other, highly publicized police killings.

Second, we used data from the Mapping Police Violence project and Google trends to find the five most searched police killings in the year before George Floyd's murder.[11] Appendix figure A.III plots the call-to-shot ratio over this time-period with additional vertical lines denoting the dates of these other incidents. Notably, we find no evidence in the time-series that reporting declined in our sample cities.

However, it is important to note that public salience of these events was dwarfed by that of the George Floyd murder and, to a lesser extent, the killing of Michael Brown. Peak search volume for each of the five other incidents never exceeded 1% of the former and 4% of the latter (see Appendix figure A.XI). Thus, the fact that we find little change in the national call-to-shot ratio could be explained by limited public awareness and does not preclude the existence of more localized effects. Indeed, zooming into incident neighborhoods, Mikdash (2022) find that police shootings in Minneapolis cause declines in shot-reporting on the order of 1-2%.[12]

4.2 Did the conviction of Floyd's murder repair community engagement?

The final question we explore is whether engagement rebounds after the disciplining of involved officers. We examine this in the context of Derek Chauvin's conviction for the murder of George Floyd, a rare but highly-visible example of police accountability. Appendix figure A.IV plots trends in 911 call-to-shot ratios in the weeks before and after the verdict was announced on April 20, 2021.[13] We find little evidence that the decision increased civilian crime reporting.

While many lauded Derek Chauvin's conviction as a ground-breaking shift in police accountability, these results reinforce the enduring harm that George Floyd's killing had on

[11] To be precise, we scraped Google trends search volume over the years 2019-2020 for every name in the Mapping Police Violence database. Then we ranked names from first to last according to which exhibited the largest trough to peak change in search volume over that time period. From there, we excluded incidents where the victim of police violence shared the same name as a celebrity, where the news story that drove the change in search volume was not directly related to the murder itself (e.g. new developments related to an ongoing court case), and where the victim of police violence died while perpetrating a mass shooting.

[12] Their analysis was released after the first public working paper of our project.

[13] This includes all sample cities except Washington, DC, for which we only have data through December 31, 2020.

public engagement and cooperation with law enforcement. They further suggest that local communities may view issues of police accountability as too endemic to be repaired with a single conviction, no matter how high-profile.

5 Conclusion

Together, our results provide novel insight into the deleterious effects that high-profile acts of police violence may have on civilian crime reporting. These effects are large, persistent and widespread. We find that George Floyd's murder by Minneapolis police spurred a roughly 50% drop in 911 calls per gunshot, an effect that is mirrored across multiple cities and racial groups and that persisted over time.

In light of these findings, it is natural to wonder the extent to which our findings are applicable to other instances of aggressive policing. While prior research has found corroborating evidence of police violence's negative impact on community health, these effects tend to be highly-localized. However, existing studies also examine older incidents that occurred before the rise of cell phone cameras, social media platforms and recent social justice movements. In this light, the far-reaching consequences of George Floyd's death may well predict the modern aftermath of controversial police killings, though this can only be confirmed with further research. At minimum, our findings suggest that public cooperation with police may have been fundamentally altered by George Floyd's murder and that any future incidents will be assessed from a new baseline of heightened distrust and skepticism.

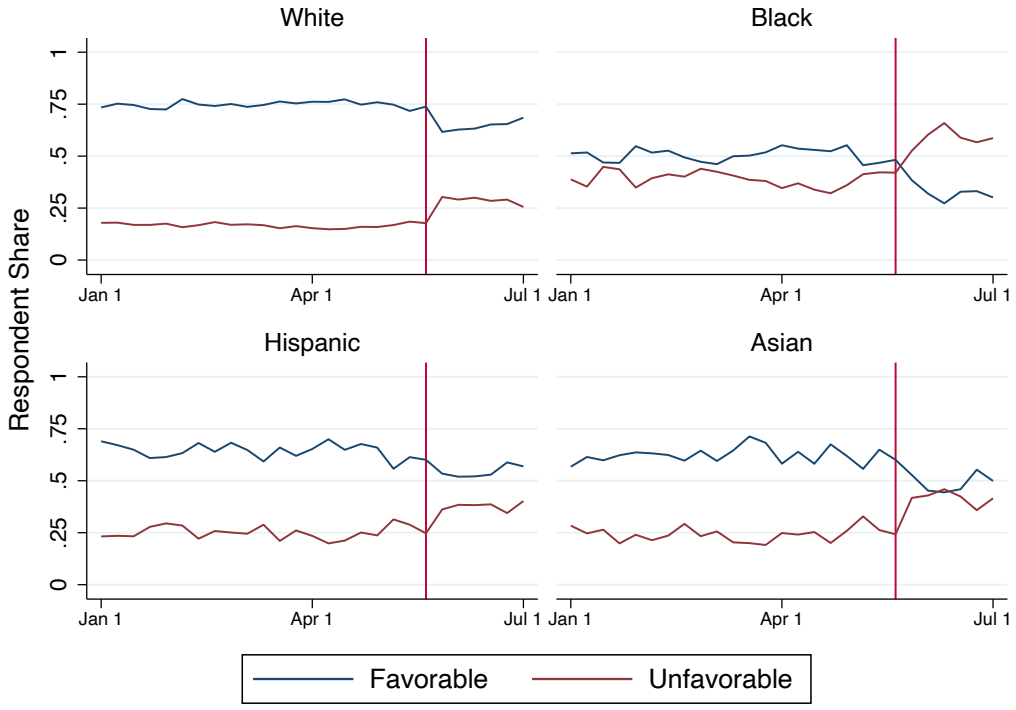
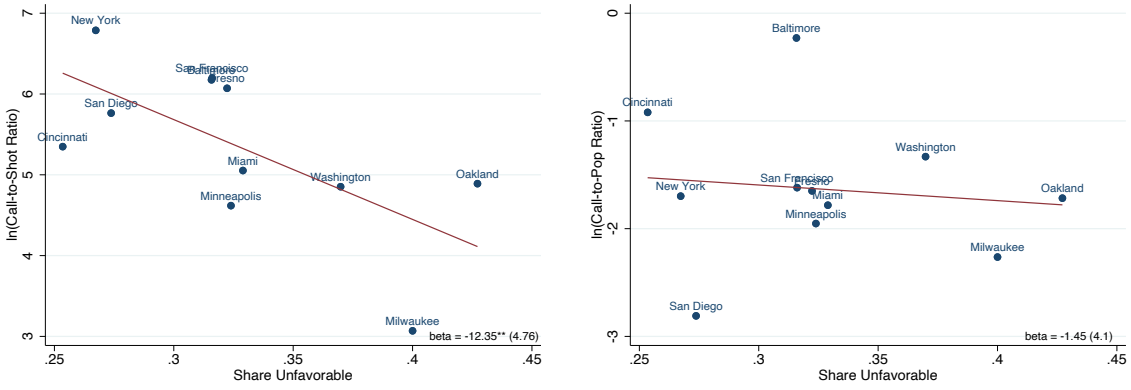


Figure I: Perceptions of Police over Time

Notes: Figure plots weekly police favorability ratings by respondent race. Data come from Nationscape, which include weekly surveys of 6,250 individuals (repeated cross-section). Respondents are asked to rate, on scale of 1 to 5, how favorably they view police. Blue line represents share of respondents with positive views (i.e., 4 or 5 rating). Red line represents share of respondents with negative views (i.e., 1 or 2 rating). Red vertical line represents the week of George Floyd's death.

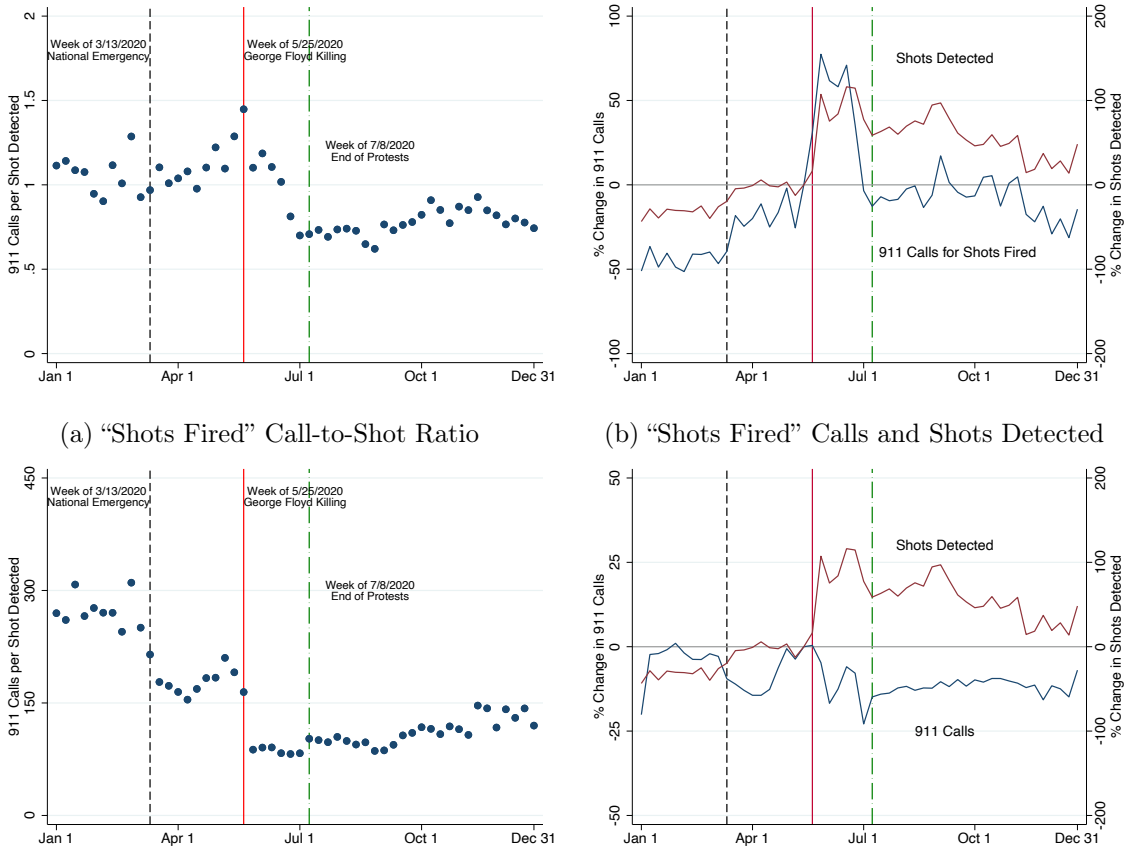


(a) Calls per Shot

(b) Calls per Resident

Figure II: Predicting police favorability with calls-to-shots

Notes: Panel (a) plots the natural log of the call to shot ratio against average police favorability from the Nationascape data for each of the 13 cities in our sample. The slope of the best fit line is 6.27 with standard error of (2.57). Panel (b) is identical to panel (a) except that we replace the call to shot ratio with the call to population ratio. the slope of this best fit line is 1.37 with a standard error of (6.05).



(a) "Shots Fired" Call-to-Shot Ratio

(b) "Shots Fired" Calls and Shots Detected

(c) Call-to-Shot Ratio

(d) 911 Calls and Shots Detected

Figure III: Civilian Crime Reporting over Time

Notes: Panel A plots the ratio of 911 calls described as relating to gunshots to acoustically detected shots over time. Calls and shots are aggregated by week across gunshot coverage areas in our thirteen sample cities. Panel B plots the percent change in "Shots Fired" 911 calls and shots over time, relative to the value of each variable during the week prior to George Floyd's death. Panels C and D are identical except that we use all 911 calls instead of restricting to calls relating to gunfire. Dashed vertical line represents the week the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death. Dashed green line marks the end of rioting and Black Lives Matter protests.

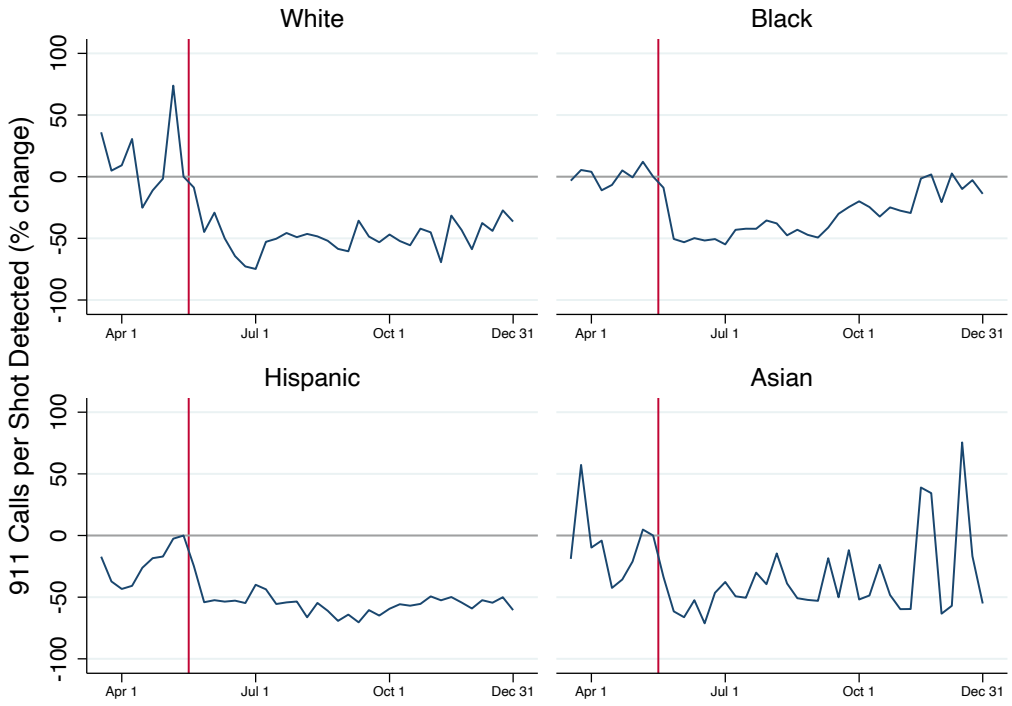


Figure IV: Civilian Crime Reporting by Neighborhood Race

Notes: Figure plots the percent change in the ratio of 911 calls to ShotSpotter shots over time by neighborhood racial composition. For example, the top-left figure aggregates 911 calls and ShotSpotter shots across all majority-white neighborhoods in the sample (i.e., Census tracts with >50% white residents in 2015-2019 ACS). For each neighborhood type, percent change is calculated relative to the call-to-shot ratio during the week prior to George Floyd's death. Due to noise from the small number of majority-Asian tracts in our sample, we censor percent changes in call to shot ratio for those neighborhoods at 100% in order to display all subfigures on the same scale. Sample is limited to weeks after the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death.

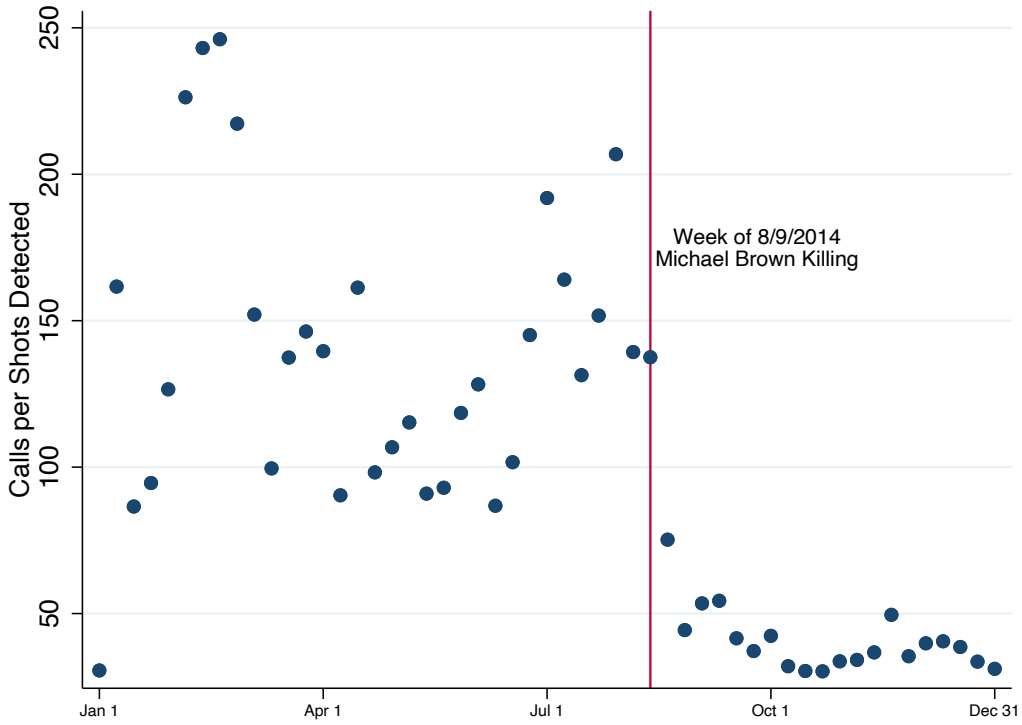


Figure V: Civilian Reporting after the Murder of Michael Brown

Notes: This figure plots the ratio of 911 calls to acoustically detected gun shots for the year 2014. Calls and shots are aggregated by week across gunshot coverage areas in two cities: Milwaukee and Minneapolis. Red vertical line represents the week of Michael Brown's death.

Table I: Average Effects on Civilian Crime Reporting

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: DV = Calls-to-Shots							
Post Floyd	-101.16***	-110.74***	-52.71***	-65.25***	-84.86***	-101.05***	-59.59***
	(8.01)	(21.04)	(6.91)	(8.88)	(8.54)	(8.16)	(17.18)
Panel B: DV = Log(Calls-to-Shots)							
Post Floyd	-0.73***	-0.83***	-0.35***	-0.43***	-0.59***	-0.73***	-0.37***
	(0.06)	(0.16)	(0.05)	(0.07)	(0.07)	(0.06)	(0.13)
Panel C: DV = Calls-to-Violence							
Post Floyd	-810.02***	-441.81***	-783.42***	-768.13***	-615.33***	-810.89***	-301.22*
	(95)	(168.37)	(119.9)	(126.27)	(85.78)	(94.59)	(162.14)
Panel D: DV = Log(Calls-to-Violence)							
Post Floyd	-0.88***	-0.58***	-0.78***	-0.73***	-0.7***	-0.88***	-0.4***
	(0.08)	(0.19)	(0.13)	(0.15)	(0.09)	(0.08)	(0.16)
Observations	146	146	146	146	146	146	146
Time Trend (Days)	No	Yes	No	No	No	No	Yes
Lagged Dependent Variable	No	No	Yes	Yes	No	No	Yes
Twice Lagged Dependent Variable	No	No	No	Yes	No	No	Yes
Google Mobility	No	No	No	No	Yes	No	Yes
911 Calls from 2019	No	No	No	No	No	Yes	Yes

Notes: Table displays results from regressions of the form $Y_t = \beta D_t + \pi X_t + \epsilon_t$ where D_t takes a value of 1 after George Floyd's murder so that beta measure the average size of the reporting decline after accounting for controls contained in X_t. The sample spans the 73 days between the COVID-19 National Emergency on March 13, 2020 and George Floyd's murder on May 25, 2020 plus the 73 afterwards. Panels A and B present results where the dependent variable is the all calls-to-shots ratio in levels and in logs. Panels C and D present results where the dependent variable is the all calls-to-gun violence casualty ratio in levels and in logs. Column (1) is our baseline model. Column (2) controls for a time trend. Columns (3) and (4) control for once and twice lagged dependent variables, respectively. Column (5) includes controls for the amount of time spent in places of residence based on Google tracking data. Column (6) includes controls for total 911 call volume as measured on the same date in 2019. Column (7) includes all controls simultaneously. Newey-west standard errors are contained in parentheses.

Table II: Average Effects on Victim Non-Reporting by Reason (National Crime Victimization Survey)

	(1)	(2)	(3)
Panel A: DV - Non-Report due to Police Mistrust			
Post-Floyd	0.015**	0.014**	0.015**
	(0.005)	(0.005)	(0.004)
Mean	0.084	0.084	0.084
Panel B: DV - Non-Report due to Private Concern			
Post-Floyd	-0.005	-0.006	-0.005
	(0.004)	(0.004)	(0.004)
Mean	0.213	0.213	0.213
Observations	22,757	22,756	22,756
Month Fixed Effects	Yes	Yes	Yes
Victim Characteristics	No	Yes	Yes
Incident Characteristics	No	No	Yes

Notes: Table displays results from regressions of the form $Y_t = \beta D_t + \pi X_t + \epsilon_t$ *where* D_t *takes a value of 1 after George Floyd's murder (from June 2020 onwards) so that beta measure the average size of the reporting decline after accounting for controls contained in* X_t*. Sample includes all NCVS crime victimizations from January 2019 to August 2021. Data are at the incident-level and identified to the month. Panel A examines an indicator set to 1 for incidents that were unreported to police because the respondent claimed "police wouldn't think it was important enough", "police would be inefficient, ineffective" or "police would be biased, would harass/insult respondent, cause respondent trouble, etc." Panel B examines an indicator set to 1 for incidents that were unreported to police because the respondent claimed the incident was "private or personal matter or took care of it myself or informally" or "minor or unsuccessful crime, small or no loss, recovered property." Column (1) includes calendar month fixed effects. Column (2) includes controls for victim age, gender and race. Column (3) includes controls for crime type and incident location. Standard errors are clustered by month-year and reported in parentheses.*

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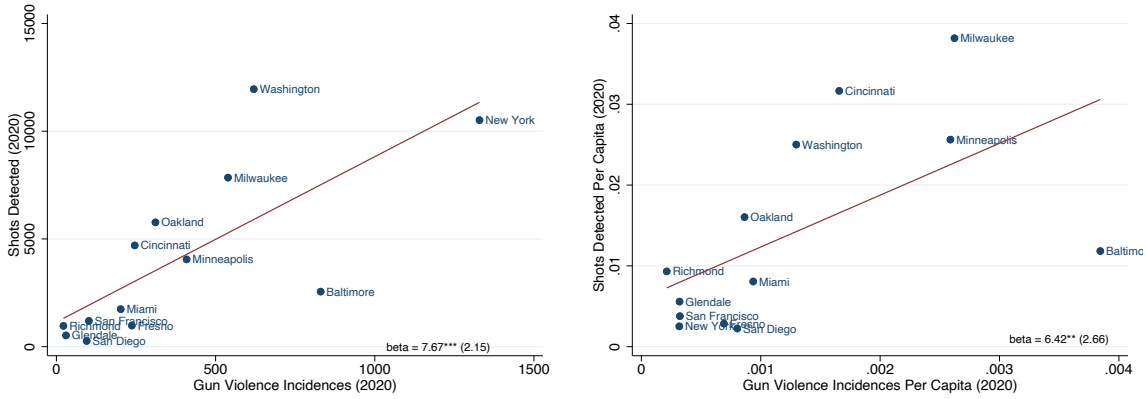


(a) Levels (b) Per-Capita

Figure A.I: Correlation Between Acoustically Detected Gunshots and Gun Violence Casualties

Notes: This figure plots the cross-city relationship between the number of acoustically detected gunshots and reported gun violence casualties. Panel (a) presents the relationship in levels. Panel (b) presents the relationship adjusting for population.

Figure A.II: Civilian Crime Reporting by City

Notes: Figure plots the percent change in the ratio of 911 calls to acoustically detected gunshots over time by city. For each city, percent change is calculated relative to the call-to-shot ratio during the week prior to George Floyd's death. Sample is limited to weeks after the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death.

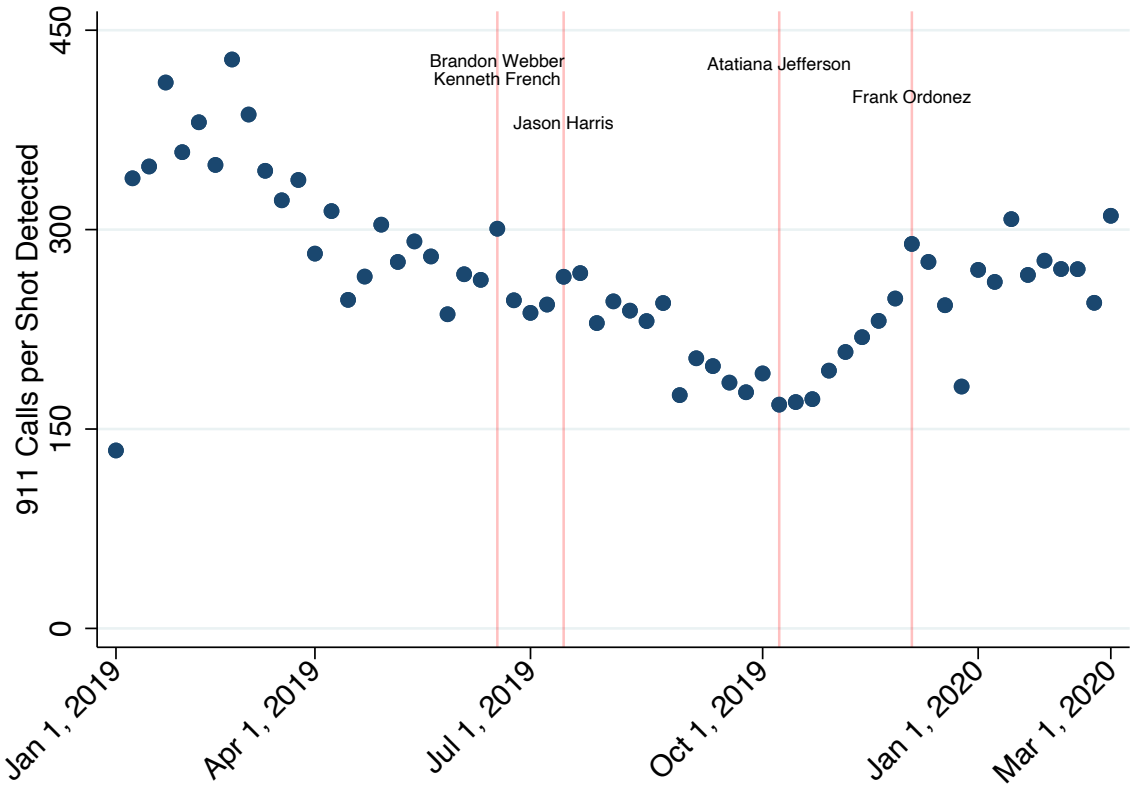
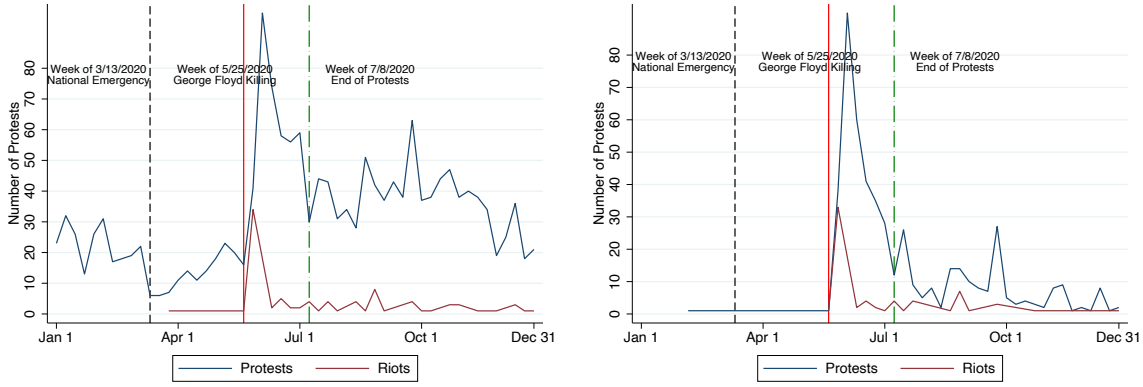


Figure A.III: Other salient acts of police violence

Notes: Figure plots the ratio of 911 calls to acoustically detected shots over time for January 1 to July 1, 2021. 911 calls and shots detected are aggregated by week across acoustic gunshot detection coverage areas. Red vertical lines denote the four most salient police killings (as measured by google trends) that were contained in the mapping police violence database and that occurred prior to George Floyd's murder.

Figure A.IV: Civilian Crime Reporting after Chauvin Conviction

Notes: Figure plots the ratio of 911 calls to acoustically detected gunshots over time for January 1 to July 1, 2021. 911 calls and shots detected are aggregated by week across acoustic gunshot detection coverage areas in all sample cities except Washington, DC (for which we only have acoustic gunshot detection data until December 31, 2020). Red vertical line represents the week of Derek Chauvin's conviction.

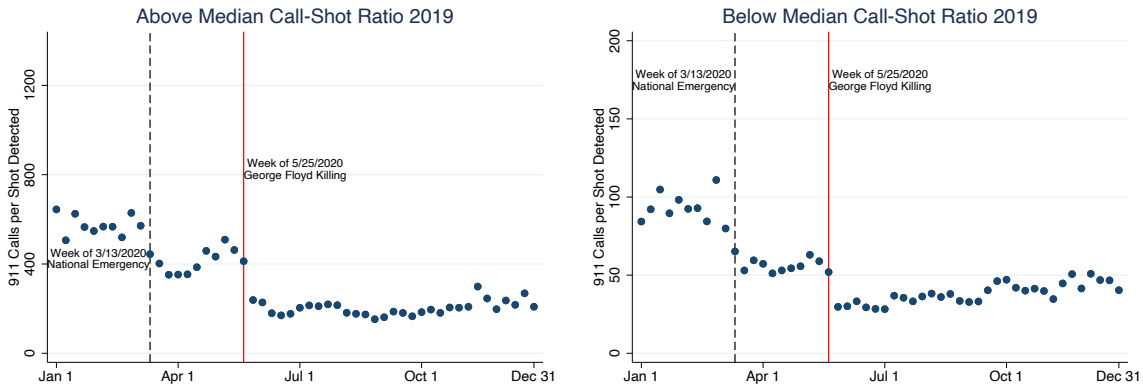


(a) All Riots/Protests

(b) Riots/Protests about George Floyd or BLM

Figure A.V: Riots and Protests in the Aftermath of the Murder

Notes: Panel (a) plots the number of protests and riots that occurred in each of our 8 sample cities over the same time period considered in figure III. Panel (b) is identical to panel (a) except restricted to riots and protests that were specifically in response to George Floyd's murder. Riots and protests are measured using data from the Armed Conflict Location and Event Data (ACLED) project. According to the ACLED website, these data are collected from select "local, national and international sources, including media, vetted social media accounts, government and NGO reports, and partner organizations," (ACLED, n.d.).

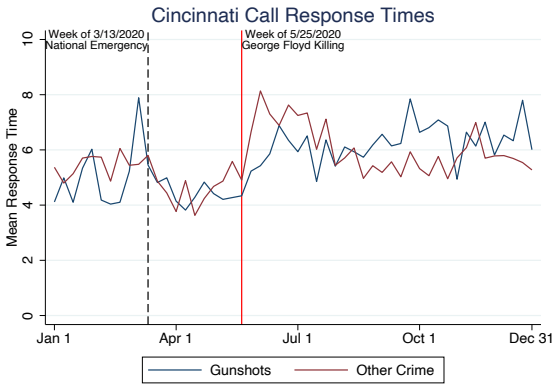


(a) Above median call-shot ratio 2019

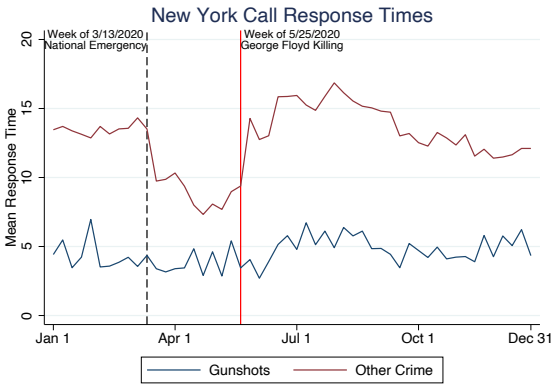
(b) Below median call-shot ratio 2019

Figure A.VI: Call-to-shot Declines by Baseline Reporting

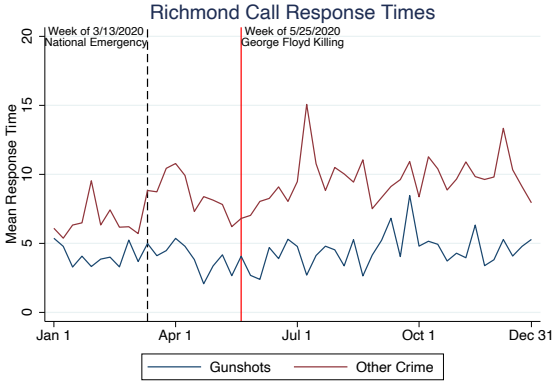
Notes: Both panels of this figure are identical to panel (c) of figure III from the main text except that we restrict to the sub-sample of census tracts which are above or below the median in the call-to-shot ratio at baseline.



(a) Cincinnati



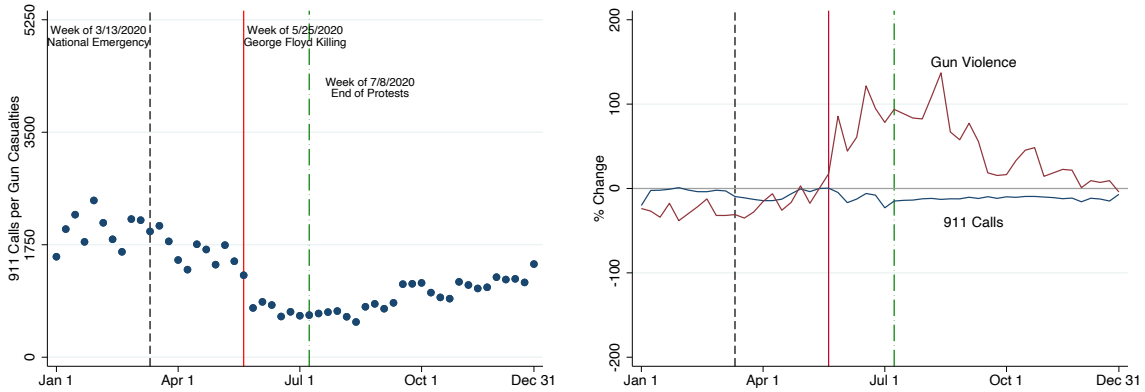
(b) New York City



(c) Richmond

Figure A.VII: Police Response Times

Notes: Figure plots the average police response at the weekly level during 2021 for Gunshots and all other crime for three cities in our data. Police response times are found in the 911 call logs for these three cities, but were not available in the public 911 call logs for the remaining five cities in our data.

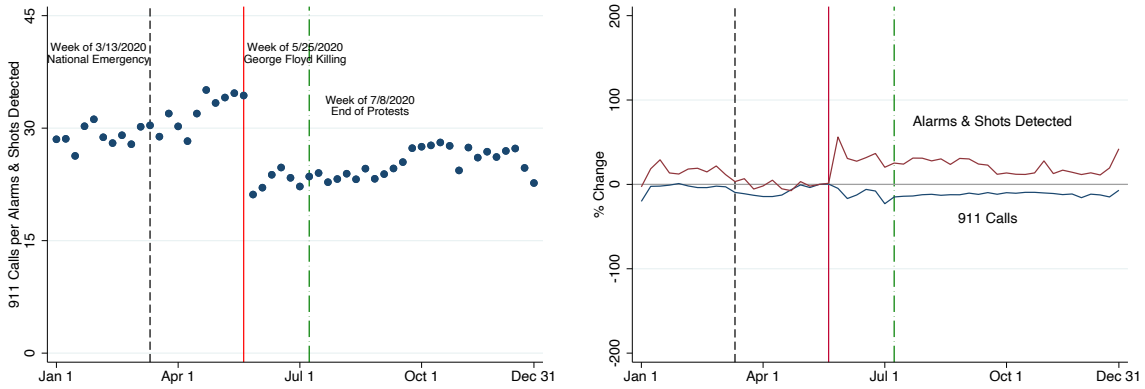


(a) Call-to-Casualty Ratio

(b) Calls and Casualties

Figure A.VIII: Civilian Crime Reporting over Time (911 Calls to Gun Violence Casualties)

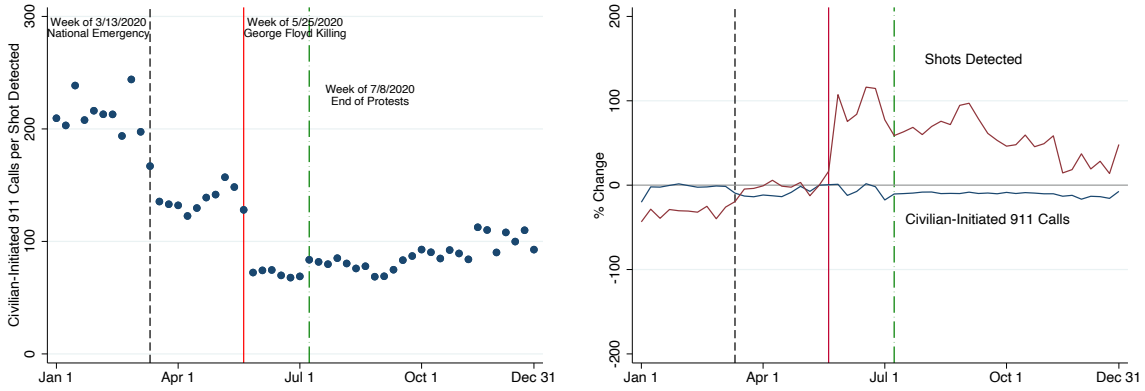
Notes: Panel A plots the ratio of 911 calls to gun violence casualties (i.e. deaths and injuries) over time. Data on gun violence casualties come from the Gun Violence Archive (gunviolencearchive.org). 911 calls and gun casualties are aggregated by week across acoustic gunshot detection coverage areas in all eight sample cities: Baltimore, Cincinnati, Washington (DC), Milwaukee, Minneapolis, New York, Richmond (California) and San Diego. Panel B plots the percent change in 911 calls and gun violence casualties over time, relative to the value of each variable during the week prior to George Floyd's death. Dashed vertical line represents the week the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death.



(a) 911 Calls to Shots Plus Alarms Ratio (b) 911 Calls and Shots Plus Alarms

Figure A.IX: Civilian Crime Reporting over Time (911 Calls to Shots Plus Alarms)

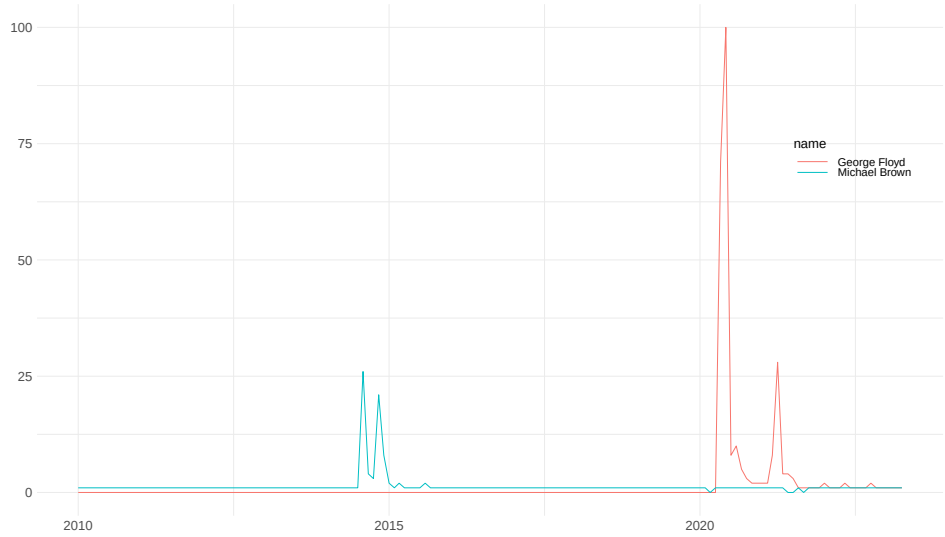
Notes: Panel A plots the ratio of 911 calls to the sum of acoustically detected gunshots and automated alarms over time. 911 calls and shots detected plus automated alarms are aggregated by week across acoustic gunshot detection coverage areas in all thirteen sample cities. Panel B plots the percent change in 911 calls and the sum of acoustically detected gunshots and automated alarms over time, relative to the value of each variable during the week prior to George Floyd's death. Dashed vertical line represents the week the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death.



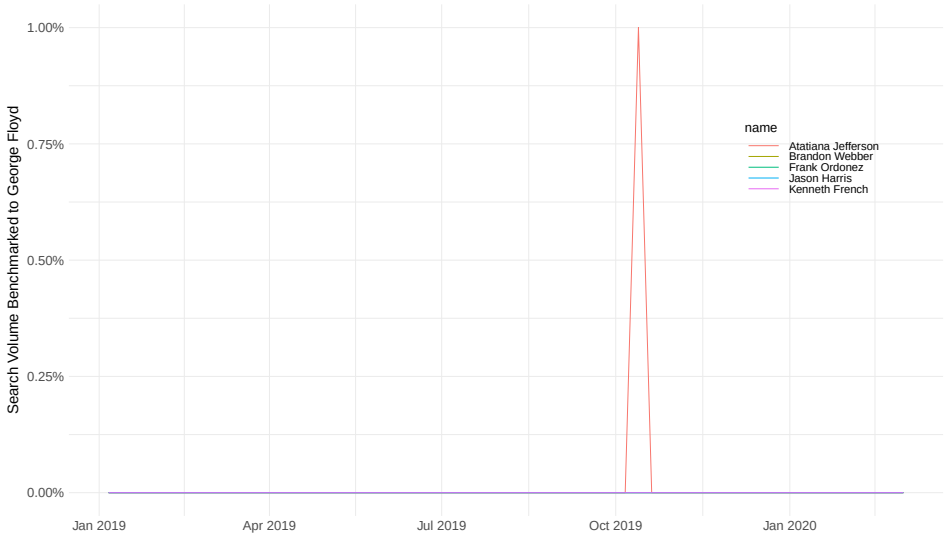
(a) Civilian-Initiated Call-to-Shot Ratio (b) Civilian-Initiated Calls and Shots Detected

Figure A.X: Civilian Crime Reporting over Time (Civilian-Initiated Calls to Shots Detected)

Notes: Panel A plots the ratio of civilian-initiated 911 calls to acoustically detected gunshots over time. To identify civilian-initiated 911 call volumes, we exclude calls with descriptions related to traffic stops and patrols, which may instead result from proactive policing encounters. Civilian-initiated 911 calls and shots detected are aggregated by week across acoustic gunshot detection coverage areas in all thirteen sample cities. Panel B plots the percent change in civilian-initiated 911 calls and acoustically detected gunshots over time, relative to the value of each variable during the week prior to George Floyd's death. Dashed vertical line represents the week the COVID-19 National Emergency was declared. Red vertical line represents the week of George Floyd's death.



(a) Michael Brown murder



(b) Most salient murders in 2019

Figure A.XI: Other highly salient acts of police violence

Notes: Figure presents Google trends data for other nationally salient police killings. Panel (a) displays search volume for the Michael Brown and George Floyd murders. Panel (b) displays the 5 most nationally salient, non-George Floyd related police killings in 2019 as found in the mapping police violence data. In both panels, search volume is benchmarked to peak search volume for "George Floyd" in 2020. Note that in order to see any variation in panel (b), we had to re-scale the axis to run from 0-1%, whereas the top panel runs from 0-100%.