Improving Nonfatal Shooting Clearance Rates in Denver: A Retrospective Evaluation

Anthony A. Braga[1*], Philip J. Cook[2], Lisa M. Barao[1], Ajenai Clemmons[3], Brandon Turchan[4], Aaron Chalfin[1], and John MacDonald[1]

1 – Department of Criminology, University of Pennsylvania
2 – Sanford Institute of Public Policy, Duke University
3 – Korbel School of International Studies, University of Denver
4 – School of Criminal Justice, Michigan State University

* Corresponding author. Department of Criminology, University of Pennsylvania, 558 McNeil Building, 3718 Locust Walk, Philadelphia, PA, USA; abraga@upenn.edu

Abstract

Research suggests that police departments should invest additional resources in the investigation of nonfatal shooting cases. When additional investigative effort is expended, police should improve their success in gaining the cooperation of key witnesses and increase the amount of forensic evidence collected and analyzed. In turn, the capacity of the police to hold violent gun offenders accountable, deliver justice to victims, and prevent future gun attacks should be enhanced. This paper presents the results of a retrospective evaluation of a well-known police program to improve nonfatal shooting case clearance rates in Denver, Colorado. To the research team's knowledge, this study is the first formal evaluation to test whether strengthening the investigative practices of police departments can improve NFS clearances. When completed, the results have the potential to significantly change the dynamics around shootings and violent crime in other major cities.

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Background

Policymakers and researchers have been increasingly interested in why clearance rates for crime in general is so low—even for serious violent crimes and even given advances in forensics and technology. Police departments in many large cities in the United States have abysmal nonfatal shooting (NFS) clearance rates.[1] While research has largely failed to quantify the effect of the failure to clear cases, there are many reasons to think the effect of low clearance rates may be profound—violent offenders are not held accountable, justice is not delivered to victims, communities lose confidence in their government and justice system, and future gun attacks are not prevented.

In 2021, Arnold Ventures commissioned a review of the evidence on criminal investigations and case clearances, and followed the publication of this review with a conference discussion. Two details from that publication and conference are worth highlighting:

- There has been very little rigorous evidence on how police might improve clearance rates, with very few studies focused on causation.[2]
- "…newer research findings suggest that investigations-specific organizational policies focused on strengthening the capacity and accountability of investigative work, applying targeted resources to investigations, and increasing investigative effort in developing witnesses, evidence and responding to crime scenes could improve an agency's ability to affect clearance rates."[3]

In sum, there is a growing body of evidence on how various characteristics of police investigations affect success rates for violent crime, but the research designs are for the most part not strong enough to establish causal relationships. In the absence of strong evidence,

[1] In 2021, the Philadelphia Police Department (PPD) only cleared 12% of 1,930 nonfatal shooting cases involving more than 2,300 victims. In 2016, the Chicago Police Department cleared less than 12 percent of its city's non-fatal shootings, San Francisco Police Department cleared only 15 percent of its gun assaults, and Los Angeles Police Department cleared 17 percent of its gun assaults. However, in some cities, it is questionable whether homicide units are adequately resourced to investigate the flow of cases that detectives inherit. In 2017, the Baltimore Police Department had 57 homicide detectives assigned to investigate 483 murder cases and, not surprisingly, only 25 percent of fatal shootings were cleared; their citywide shooting unit had just 26 detectives to investigate some 703 cases and cleared roughly 23 percent of them. For a review, see Braga, A. A. (2021). *Improving Police Clearance Rates of Shootings: A Review of the Evidence.* New York: The Manhattan Institute.

[2] Some notable exceptions included: Cook, P. J., Braga, A. A., Turchan, B., & Barao, L. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18, 525 – 552; Braga, A. A., & Dusseault, D. (2018). Can homicide detectives improve homicide clearance rates? *Crime & Delinquency*, 64, 283 – 315; Braga, A. A., Turchan, B., & Barao, L. (2019). The influence of investigative resources on homicide clearances. *Journal of Quantitative Criminology*, 35, 337 – 364.

[3] Lum, C., Koper, C., & Prince, H. (2022). *Building Evidence for Effective Investigations: A Collaborative Workshop to Identify Research Needs.* Fairfax, VA: Center for Evidence Based Crime Policy, George Mason University.

conclusions regarding worthwhile reforms are speculative. Going forward, quasi-experimental evaluations of relevant reforms are a promising basis for generating stronger evidence on particular interventions. The proposed paper will present an evaluation of the most prominent and promising reform in recent years, the Denver Police Department's Firearm Assault Shoot Team (FAST) program, launched in 2020. If it proves cost-effective, the FAST program will serve as a proof of concept that expanding investigative resources can, under particular circumstances, be sufficient to increase clearance rates.

However, for program-design purposes it is not enough to evaluate specific reforms. It is also important to explore the underlying mechanisms which spell success or failure of investigations.[4] For NFS, victim cooperation is important – even essential – to success. This analysis will explicitly seek to document the role of the victim in NFS investigations. The evaluation of FAST in Denver will include an analysis of the victim's role in hundreds of cases, together with interview data intended to better understand how FAST detectives seek to overcome or circumvent victim noncooperation in NFS cases.

Literature Review

In evaluating the techniques and overall efficacy of crime investigation, it is important to distinguish between types of crime. Unlike most property crimes, violent crimes typically involve eyewitnesses (the victim, for one) who figure importantly in successful investigations. The landmark RAND Corporation study included a detailed study of investigation data from Kansas City, Missouri, and the authors found that in 35% of successful homicide investigations, and in fully 63% of successful investigations of aggravated assault, the victim or a witness identified the suspect.[5] But it should be pointed out that the importance of witnesses in solving these cases does not imply that detective work gets none of the credit. Not infrequently, key witnesses are reluctant to talk, so that success requires locating witnesses and persuading them to cooperate.

More recently, researchers have analyzed the specific techniques used by investigators in serious crimes. It should be noted that most of this research has been descriptive and has not included

[4] Ludwig, J., Kling, J., and Mullainathan, S. (2011). Mechanism experiments and policy evaluations. *Journal of Economic Perspectives*, 25: 17 – 38.

[5] Greenwood, P. W., Chaiken, J. M., & Petersilia, J. (1977). *The investigation process*. Lexington, MA: Lexington Books.

clear statistical identification of a causal effect. For example, an analysis of homicides in four large cities in 1994 and 1995 identified several investigation-related factors that were associated with the likelihood of arrest, including what the first responding officer did at the scene, how quickly a detective arrived on the scene, whether the crime lab and medical examiner's officer were informed, the number of detectives assigned to the case, and how the scene was documented.[6] Other research has found police departments can improve homicide clearance rates by training detectives and other personnel involved in investigations, implementing case management systems, establishing collaborative relationships with external agencies, and having a strong community presence.[7]

Some studies have found that forensic analysis of physical evidence collected at the initial crime scene has little statistical association with clearance rates.[8] The value of forensic evidence may be attenuated by long delays in processing such evidence. But a recent study of homicide clearances in Boston[9] found a strong statistical association with a variety of investigative actions, including forensics testing conducted both before and after arrest.[10]

Experimental and quasi-experimental studies in criminal investigations have been rare. The descriptive studies cited earlier provide suggestive evidence, but they were not designed to identify reliably whether the observed statistical associations are a result of a direct causal effect, reverse causation, or some other process. For example, investigators may tend to devote more effort to promising cases, with the implication that the positive association between effort and

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[6] Wellford, C., & Cronin, J. (1999). *An analysis of variables affecting the clearance of homicides: A multistate study*. Washington, DC: Justice Research and Statistics Association.

[7] See, e.g., Keel, T. G., Jarvis, J. P., & Muirhead, Y. E. (2009). An exploratory analysis of factors affecting homicide investigations: Examining the dynamics of murder clearance rates. *Homicide Studies*, *13*, 50–68; Richardson, D. A., & Kosa, R. (2001). *An examination of homicide clearance rates: Foundation for the development of a homicide clearance model*. Washington, DC: Police Executive Research Forum; Carter, D. L., & Carter, J. G. (2016). Effective police homicide investigations: Evidence from seven cities with high clearance rates. *Homicide Studies, 20*, 150–176.

[8] E.g., see Baskin, D., & Sommers, I. (2010). The influence of forensic evidence on the case outcomes of homicide incidents. *Journal of Criminal Justice*, *38*, 1141–1149; McEwen, T., & Regoeczi, W. C. (2015). Forensic evidence in homicide investigations and prosecutions. *Journal of Forensic Sciences*, *60*, 1188–1198; Schroeder, D. A., & White, M. D. (2009). Exploring the use of DNA evidence in homicide investigations, implications for detective work and case clearance. *Police Quarterly, 12*, 319–342.

[9] Braga, A. A., Turchan, B., & Barao, L. (2019). The influence of investigative resources on homicide clearances. *Journal of Quantitative Criminology*, 35, 337 – 364.

[10] It should be noted that much of the forensic testing is less for the purposes of identifying a suspect than for making a case against a suspect that would hold up in court. For instance, a clearance of an offender caught at the scene with a smoking gun and cooperative eyewitnesses will still involve forensic testing. The gun will be matched to the cartridge casings and bullets, the offender will be fingerprinted as will the gun, and often the offender is tested for gunshot residue.

success would be partly the result of reverse causation. Given the ambiguity of correlational evidence regarding causal process, it is important to study the effect of interventions, but we know of only one study in which the authors have done so.

Following a study and the recommendations of an expert panel, the Boston Police Department launched several reforms affecting homicide investigations beginning on January 1, 2012. The reforms included the assignment of additional detectives to the homicide unit, the standardization of investigative procedures and forensic reviews, improved training for investigative personnel, and peer review of open investigations.[11] Several measures of investigative activity in homicide cases increased, and the homicide clearance rate increased from 47% during the 5 years before the reform to 57% during the 3 years after it. Other jurisdictions that served as plausible control groups were tracked and did not exhibit a comparable jump in clearance rates.

A subsequent study used a quasi-experimental design to compare investigative resources invested in clearing gun homicide cases relative to nonfatal gun assaults in Boston. The authors found that the large gap in clearances (43% for gun murders vs. 19% for nonfatal gun assaults) was primarily a result of sustained investigative effort in homicide cases made after the first two days.[12] These findings suggest police should invest additional resources in the investigation of nonfatal gun assaults. When additional investigative effort is expended, law enforcement improves its success in gaining the cooperation of key witnesses and increases the amount of forensic evidence collected and analyzed. In turn, the capacity of the police to hold violent gun offenders accountable, deliver justice to victims, and prevent future gun attacks is enhanced.

Program Design and Implementation

In 2019, the Denver Police Department (DPD), faced with increasing rates of gun violence, launched a reform designed to increase clearance rates for NFS.[13] At that time, investigations of most nonfatal shootings were handled by district detectives who were also responsible for a large volume of other cases of violent and property crime. DPD decided to centralize the investigation

[11] Braga, A. A., & Dusseault, D. (2018). Can homicide detectives improve homicide clearance rates? *Crime & Delinquency*, 64, 283 – 315.
[12] Cook, P. J., Braga, A. A., Turchan, B., & Barao, L. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18, 525 – 552.
[13] This description of FAST is based on a conversation with Denver Police Department executives on May 17, 2022: Lt. Matt Clark (Commander of Major Crimes Division), and Dr. Matthew Lunn (Manager of Strategic Initiatives). Professor Clemmons attended this discussion in person and moderated the discussion; Professor Cook called in. Drs. Clemmons and Cook took detailed notes.

of NFS cases and assign them to a new unit, the Firearm Assault Shoot Team (FAST). The team initially consisted of a supervisor and five detectives who were appointed because of their skill in working with victims. These detectives received extra training to prepare them for the kinds of evidence common in shooting cases. Starting in February 2020, this team's only responsibility was investigating assaults in which a victim was intentionally shot and injured, and the goal was to investigate these cases with the same priority as if they were homicides. A FAST detective is assigned to each such investigation from the beginning.

Since FAST's launch, staffing has grown to nine detectives and two supervisors, providing sufficient capacity to investigate every shooting in the city with the exception of gang-related cases (which are handled by the Special Operations Response Team). NFS cases also have a high-priority claim on the crime lab and other resources. (Note that DPD has the advantage of having its own crime lab.) Early reports suggest that this reform has been successful in increasing arrest rates for NFS cases. During its first year of operation, 2020, FAST handled 186 NFS cases in Denver, and cleared 66% of them – a notable increase over the previous year. The clearance rate has dropped somewhat since then but remains high.

Shooting Cases Handled by Firearm Assault Shoot Team (FAST)

Year	Number of crime cases with nonfatal gunshot wound*	Cleared*	
2020	186	122	66%
2021	179	87	49%
2022*	65	36	55%

*YTD 5/13/22 *Number of victims w/GSW

***Includes all "Cleared" dispisitions:**
Arrest,Warrant, Refused by DA, Referred to other agency, Unfounded

FAST represents the best-case scenario – a well-resourced program that has the sustained support of the departmental command staff. It has become a model for other departments that are considering a similar reform. But so far it has not been subjected to an external arms-length evaluation. The study will include a quantitative impact evaluation and detailed description of the FAST process.

General Evaluation Approach

The impact evaluation will use DPD's crime data (which is in NIBRS format), from 2017 through 2023. The primary goal of FAST was to reduce shootings by increasing the arrest and

conviction rates for shooters in NFS cases, and that goal defines the relevant outcomes for the evaluation. While a sharp discontinuity in the clearance rate at the time FAST was implemented would provide evidence in support of its effectiveness, we will also utilize one or more comparison groups. A natural comparison group consists of gun assaults and robberies in which the victim was not shot. (These cases greatly outnumber the shooting cases.) An increase in the clearance rate of NFS cases in comparison with the clearance rate for other cases of gun violence would provide strong quasi-experimental evidence of the effectiveness of FAST. Differences-in-differences estimators in multivariate regressions will be used to calculate the impact of the enhanced investigation intervention (see next section).

We will also include a process analysis, based on interviews with DPD executives and the detectives assigned to FAST, as well as a close reading of investigation files. In addition to documenting the experience and case load of detectives handling NFS cases, and other resources available to the FAST unit, the detectives will be interviewed to determine how investigation procedures have changed as a result of FAST and how they account for the increase in the clearance rate for NFS cases. Of particular interest is the issue of victim cooperation. Have the FAST detectives found ways to overcome victim reluctance to cooperate? Or have the detectives found ways around victim non-cooperation? The answers to these questions will be of interest in understanding results from the quantitative analysis, and be of considerable interest in providing guidance to other departments.

Here is one example: if a victim refuses to cooperate and to testify at trial, it may still be possible to make an arrest but unlikely that the district attorney would agree to prosecute. One alternative for investigators is to pursue a weapons charge, as mentioned above, which only requires establishing that the defendant had a gun and was disqualified from possessing one due to a serious criminal record. A “felon in possession” charge could “stick” without testimony from the assault victim.

Interviews are being conducted by Professor Ajenai Clemmons, an experienced qualitative researcher on the University of Denver faculty. While all 15 detectives and supervisors who are currently or ever were with the FAST unit will be contacted, the interviews will be voluntary. Our goal is to have at least 7 detective interviews and one supervisor interview. We will also seek to interview prosecutors connected to FAST, and are interested in discussing interviews of victims and offenders with DPD (this is a sensitive subject and although it is an area we are interested in, we cannot commit to it as it will involve careful negotiations with DPD. It also may

end up widening the scope of the research beyond the budget of the project). All standard human subject protections will be observed, and any information used in reports will be anonymized. Interviews will be recorded, but only if the subject consents.

An open-ended set of questions will be pilot tested. It will cover the following topics:

- The detective's experience prior to joining FAST
- Detailed account of investigation procedures used in two recent cases for which the detective was the lead
- Methods for locating, interviewing, and gaining cooperation from the victim
- Obstacles and keys to success in investigation
- Personal motivation in solving NFS cases – serving the victim vs. serving the public

Impact Evaluation Design

The impact evaluation design is briefly summarized here and then key elements are detailed in subsequent sections.

- Unit of observation: gun-violence case
- Nonfatal Shooting (NFS) sample: 2017 – 2023.
- Outcomes: Whether a suspect is arrested and charged with a serious violent crime (aggravated assault, robbery, attempted murder) or other offense; seriousness of charge; exceptional clearance resulting from refusal to prosecute (usually due to victim non-cooperation, death of the suspect, or other circumstance where a suspect has been identified but there is a barrier to prosecution)
- Comparison groups: Firearms assaults and robberies in which the victim was not shot
- Control variables: District, victim characteristics, location, time of day and week, gang-related or other circumstances
- Method: difference-in-difference regression analysis.

The logic of using gun assaults and robberies as the comparison group is compelling since prior to FAST these cases were subject to the same sort of investigation (and by the same detectives) as the NFS cases. We expect that the clearance rates for the gun assaults and robberies without a shooting would be very similar to the clearance rates for NFS cases. If we discover from a close analysis of the data that there are systematic differences in the "pre" period, we will consider refining the comparison group.

As always with a real-world intervention (as opposed to a controlled experiment), there are several issues that will require careful attention in our analysis:

- The FAST team only handles about 75% of NFS cases. The other 25% of cases are handled by the gang unit (Special Operations Response Team, or SORT). We are assured by DPD command staff that SORT groups were in place years before FAST was created and has not changed its operations. Of course, it is possible that the criteria for assignment of NFS cases to SORT has changed over time. Our inclination is to keep the gang-related cases in the analytic sample, with the understanding that the estimated effect of FAST will be somewhat diluted by the fact that it does not "treat" all NFS cases. The same official data for the 25% of NFS cases investigated by SORT as will be collected for the 75% of cases investigated by FAST. We will also interview SORT investigators on their operations. The first goal is to provide a good description of how the cases are sorted and assigned in practice, and what difference it makes with respect to investigation resources and methods. Secondly, we would like to determine the ways in which the introduction of FAST affected case assignment and SORT resources. It seems unlikely that the creation of FAST has had no effect on which cases are assigned to SORT or what resources are available to SORT. Ultimately, our goal is to determine whether FAST has increased the overall clearance rate for nonfatal shooting cases regardless of whether they were investigated by FAST or SORT.

- Our comparison group will be all gun assaults and robberies in which the victim was not shot. Our difference-in-difference estimates would be confounded if the transfer of detectives to FAST had the effect of reducing investigative capacity for these crimes, but we are assured by DPD command staff that that was not the case – the overall number of detectives was increased to accommodate FAST.

- The primary outcome measure is whether a suspect is "arrested and charged." It should be noted that, in some cases, a suspect may not be charged with the shooting itself, but for illegal possession of a gun (which would apply if the shooter had a serious criminal record, such as a felony conviction). Especially if transferred to federal court, the gun charge carries with it the possibility of a long prison sentence. Our analysis will document the type of charges filed.

The impact analysis will be coupled with a cost-effectiveness analysis, based on an estimate of the full costs of the FAST unit. The cost per additional arrest would provide a statistic that could be compared with other interventions. A full accounting of the cost of an arrest will also account for the use of correctional resources downstream from the arrest.

The impact evaluation will also include a process analysis which will document how the FAST unit has been operating. Using qualitative methods, analysis of descriptive data and semi-structured interviews with DPD personnel, the analysis will attempt to understand how investigations of NFS cases have been affected by the creation of the FAST unit? The reduced caseload, additional training, and other resources would be expected to improve evidence collection and processing. Of particular interest is the ability of FAST detectives to interview victims and gain their cooperation, without which it is rarely possible to establish probable cause for an arrest.

Data

Sources

The proposed evaluation will use data collected between 2017 and 2023 on all NFS incidents in which the victim has suffered a gunshot wound and a comparison group of all violent gun cases where the victim did not suffer a gunshot wound. A standard set of variables will be collected for both types of violent gun incidents such as location, time of day / day of week, victim characteristics (age, sex, race), offender characteristics (if known; age, sex, race), and circumstances (gang / drug dispute, domestic, robbery, etc.). It should be noted that DPD crime reporting system did not record the type of injury in firearms assault and robbery cases until 2020. As a result, for prior years, it will be necessary to access investigation files to determine which victims were shot. The research team also aspires to collect detailed investigative information on NFS incidents to document how the FAST unit enhanced investigative processes during the "post" period relative to the "pre" period.

A complete profile of NFS incidents and the flow of criminal investigation will be developed from multiple sources of data. Data collection will begin with computerized NFS incident reports and other data sources to capture the population of cases during the study period. Associated 911 call data for each incident will be collected to measure response times and the number and types of officers and forensic staff dispatched to crime scenes. The DPD detective case management

system will provide data on subsequent investigative activity. DPD Crime Laboratory databases will be accessed to capture evidence submissions, forensic testing, and test results. The research team will also access hard copy case files for each NFS incident and interview investigators to capture any investigative actions that were not entered into the DPD computerized databases. Drawing on these data, the research team will code key aspects of each NFS investigation starting with the initial call-for-service to the management of the initial crime scene, the interviews of witnesses, the forensic testing of physical evidence, and ultimately the decision to arrest suspects(s) or submit the case to the grand jury for indictment. We anticipate collecting the following attributes for each case:

Investigative Resources
N district detectives
Crime scene staff time (minutes)
N officers canvassing scene
Response time (minutes)
N outside CJ agencies
N Forensic group staff
N homicide / shooting detect
N crime scene staff

Crime Scene Results
N scene witnesses interviewed
N weapons recovered
N vehicles, victim, other computer checks
N evidence collected
N officers providing information
N videos collected
Victim on scene? Interviewed?

Subsequent Actions / Forensic Tests
N post-scene witnesses interviewed
N search warrants executed
N suspect computer checks
N latent print tests
N ballistic tests
N DNA tests
N trace, pattern, other tests

Incident Characteristics
Date, time, and location
Location – residence, other indoor, outdoor
Victim sex, age, race, and other information
Suspect sex, age, race, and other (if cleared)
Victim – offender relationships
Circumstances / motive
Time to arrest / indictment (if cleared)

In addition to these items, the team will code any information on the extent and nature of contacts with the victim, whether the victim cooperated with the investigation, and whether the victim or the available witnesses provided information that was useful to the investigation.

It is well known that police incident data, such as the Federal Bureau of Investigation's Uniform Crime Reports, have shortcomings. For instance, crime incident data are incomplete, since even

serious crimes often go unreported or unrecorded.[14] However, for the crimes of greatest interest to this evaluation in which the victim is injured or killed by gunshot, the Denver PD will have something approaching a complete count.[15] In particular, hospitals are required to report gunshot-wound cases to the police. Although incident reports have flaws, careful analyses of these data can correct systematic errors.[16]

Multiple coders will be used to enter the collected investigation information into databases for subsequent analysis. To ensure coder reliability, trained research assistants will separately code the quantitative and qualitative data collected for 100 randomly selected shooting cases. Inter-rater reliability measurements, such as correlation coefficients and Kappa statistics, will be used to determine whether significant differences in case characteristics or reported investigative activities among the coders. Further training will be used to ensure reliable ratings of case attributes among coders if statistically significant differences are detected. The data collection methods described here draw upon an influential fatal and nonfatal shooting investigation research enterprise in Boston.[17] As such, we anticipate these methods will yield a reliable and valid shooting investigations dataset in Denver.

The primary goal of the evaluation is to understand the extent to which case clearance rates for NFS cases can be improved by the addition of new resources and a dedicated team of detectives. A remaining question concerns the cost of the FAST unit. This is an important question because detective time is valuable and, in the absence of the FAST unit, would be put to other uses. It is also helpful for other law enforcement agencies to understand how much they would need to invest in order to create a similar unit in their department.

Identifying the cost of the FAST unit requires that the research team adopt a perspective upon which costs can be assessed. In one sense, the FAST unit is not expected to increase DPD's budget as the resources supporting the unit are coming from other areas of DPD. As such, taxpayers may incur few if any new costs. In this sense the cost of the FAST unit is not the total

[14] Black, D. (1970). The production of crime rates. *American Sociological Review,* 35, 733 – 748.
[15] Branas, C. C., Culhane, D., Richmond, T. S., & Wiebe, D. J. (2008). Novel linkage of individual and geographic data to study firearm violence. *Homicide studies*, *12*(3), 298-320.
[16] Schneider, V.W., & Wiersema, B. (1990). Limits and use of Uniform Crime Reports. In D. L. MacKenzie, P.J. Baunach, & R. R. Roberg (Eds.), *Measuring crime* (pp. 21-48). Albany, NY: State University of New York Press.
[17] Cook, P. J., Braga, A. A., Turchan, B., & Barao, L. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18, 525 – 552; Braga, A. A., & Dusseault, D. (2018). Can homicide detectives improve homicide clearance rates? *Crime & Delinquency*, 64, 283 – 315; Braga, A. A., Turchan, B., & Barao, L. (2019). The influence of investigative resources on homicide clearances. *Journal of Quantitative Criminology*, 35, 337 – 364.

financial cost of the program but the value of foregone activities that personnel assigned to the FAST unit would have undertaken had the FAST unit not been created. For example, a detective assigned to the FAST unit might clear two additional NFS cases but, had he remained investigating burglaries, he might have cleared two burglaries instead. While we can look to the data to see if there is any sign of spillover effects to other crimes, we do not have a means of measuring costs in this way.

Instead, we will rely on a more pragmatic methodology to calculate costs that focuses the financial costs of the FAST unit and activities that result from the FAST unit's work, including. the costs of labor (wages, benefits, and overtime pay

Cost data for the FAST unit will be obtained through a review of DPD administrative records. The number of additional hours expended by the FAST unit will be multiplied by the fully loaded wage cost of the detectives involved.

Hypotheses / Outcomes

Primary Hypotheses

Clearances of nonfatal shooting cases represent the main outcome for this program evaluation. If the descriptive and inferential research described in this proposal is correct, we anticipate that the specialized DPD FAST unit should increase arrest rates. The null and alternative hypotheses are stated below. We will test the null hypothesis that FAST had no effect on arrest rates in NFS cases and will reject that hypothesis if the data are sufficient to do so.

H_O: FAST had no effect on arrest rates for cases with nonfatal gunshot injuries.

H_A: FAST was successful in increasing the likelihood of arrest for nonfatal shooting cases.

Secondary Hypotheses

The descriptive investigative data described above represent important secondary outcomes that should affected by the treatment. We anticipate that the additional investigative resources invested in the specialized FAST will result in heightened investigative resources, improved crime scene results, additional forensic testing, and more interviews with witnesses during the

pre-intervention period relative to the intervention period. Among the null hypotheses to be tested are those that concern the following:

Investigation intensity (resources)
Evidence collected from crime scene
Evidence collected following initial crime-scene investigation
Quantity and quality of information obtained from victim
Quantity and quality of information obtained from other witnesses.

Evaluation philosophy

We should note that the goal of this evaluation is not limited to classical hypothesis testing. The main goal is to provide estimates of the key magnitudes as part of a cost-benefit analysis. Most important is to develop a point estimate and statistical-interval estimate of the effect of FAST on the likelihood of arrest for NFS cases.

Sample Size / Statistical Power

As will be described further below, the quasi-experimental design will test the impact of the FAST team by comparing clearance rates for nonfatal shootings to clearance rates for robberies and assaults committed using a gun. The unit of analysis in the proposed research will be nonfatal shooting cases rather than nonfatal shooting victims. For instance, a drive-by shooting in which two passengers shoot out of a vehicle into a group of pedestrians would, for investigative purposes, represent a single case. From January 2018 through June 2022 a total of 1,274 people were shot in Denver, of which 287 died from gunshot-related injuries.
The statistical power of an experimental design represents the probability that a statistical test will fail to reject the null hypothesis when the alternative hypothesis is true (false negative; Type II error).[18] As statistical power increases, the likelihood failing to reject a true null hypothesis of no difference between treatment and control groups decreases. A common heuristic in the social sciences is that a research study has sufficient statistical power if there is an 80% likelihood that a true null hypothesis can be rejected.

Our power analysis fixes statistical power at 80% and estimates the smallest effect size we can detect, or the minimum detectable effect (MDE). To do so, we built a simulation using publicly

[18] Lipsey, M. W. (1990). *Design sensitivity: Statistical power for experimental research*. Thousand Oaks, CA: Sage Publications.

available data on gun robberies, gun assaults and nonfatal shootings from the Denver Police Department for the 2011-2020 period. We augment these data with projected data for 2021 and 2022. We then divide the data among six Denver police districts and run a series of regressions to generate an estimate of the standard error on the DID treatment effect for our eventual analysis. The standard error is derived from the linear regression described in equation (1) below. Across 1,000 simulations, the average standard error is 0.024 or 2.4 percentage points. Given 80% power and a Type I error rate of 5%, this means that the minimum effect that we would determine to be statistically significant is 6.6 percentage points. It is also likely that this estimate will shrink with the inclusion of covariates that will reduce the standard error of our DID estimate.

Based on the information we have collected, DPD was clearing approximately 25% of non-fatal shootings prior to the creation of the FAST unit. After the creation of the FAST unit, according to the Denver Post reported clearance rates have been as high as 67% in 2019 and as low as 34% in 2022.[19] Even the lower of the two estimates which we regard as more accurate in a post-2020 world we will have sufficient power in this study.

Design / Analysis

Since this is a retrospective study, randomization of shooting investigations to treatment or control condition is not possible. Quasi-experimental designs seek to approximate characteristics of a true experiment without the benefit of random allocation of units to treatment and control conditions.[20] As such, quasi-experiments do not necessarily have the same high degree of internal validity as randomized controlled trials. Nonetheless, well-designed quasi-experiments can sometimes produce results that are of similar quality to randomized controlled trials.[21] This is particularly true of "differences-in-differences" research designs in which there is pre- and post-treatment data available for both treated and comparison units. With pre-treatment data, researchers have a number of ways to test for the validity of the research design which have been

[19] https://www.9news.com/article/news/local/denver-police-solving-more-nonfatal-shootings-new-unit/73-af73db94-7aa7-4c38-83b0-c3932dd414f1

[20] Campbell, D., & Stanley, J. (1966). *Experimental and Quasi-Experimental Designs for Research.* Chicago: Rand McNally.

[21] Lipsey, M., & Wilson, D. (1993). *Practical Meta-Analysis*. Thousand Oaks, CA: Sage Publications; Berk, R., Barnes, G., Alhman, L., & Kurtz, E. (2010). When second best is good enough: A comparison between a true experiment and a regression discontinuity quasi-experiment. *Journal of Experimental Criminology*, 6(2): 191-208.

sharpened by recent advances in the applied econometrics literature.[22] In the proposed research, a quasi-experimental design will be used to compare clearance rates for nonfatal shooting cases assigned to the FAST unit relative to clearance rates violent gun incidents without gunshot injuries assigned to the unspecialized detectives.

The impact of the FAST unit on outcomes will be estimated through a difference-in-differences (DID) estimator.[23] The DID estimator, which is a mainstay of evaluation work throughout the social sciences, will evaluate the difference in nonfatal shooting case investigations outcomes during the six-year intervention period compared to during the six-year pre-intervention period, relative to the same difference for gun robbery and assault case investigation outcomes. The general equation for our regression models will be:

$$Y_{it} = \beta_0 + \beta_1 NFS_i + \beta_2 Period_t + \beta_3 (NFS_i \times Period_t) + u_i \qquad (1)$$

In this model, (Y_{it}) represents our outcome measure for nonfatal shooting investigations (i) during a specific observation period (t). This will either be whether an arrest was made or whether the case resulted in at least one criminal conviction. The regressor, *NFS,* is a dummy variable identifying whether the case is a nonfatal shooting (1) or not (0). The reference group are gun robbery or assault cases in which the victim was not ultimately shot. The regressor *Period* is a dummy variable for whether the nonfatal shooting occurred during the time (t) of the intervention (2017-2022) or during the pre-intervention period. Our primary interest is in coefficient, β_3, which represents the DID estimate of the product of the NFS indicator and the intervention period. In other words, β_3 tells us the extent to which case clearance rates changed more for NFS cases than other types of gun cases after the establishment of the FAST unit. Standard errors will be clustered by division to guard against unmeasured dependence within divisions biasing the estimates of the FAST unit's impact on nonfatal shooting investigation case outcomes.

Given the possibility for imbalances in the circumstances of non-fatal shootings versus other gun crimes, the DID models will be estimated conditioning on a vector of covariates that capture characteristics of each incident (victim characteristics, motives, outdoor v. indoor locations) to

[22] Callaway, Brantly, and Pedro HC Sant'Anna (2021). "Difference-in-differences with multiple time periods." *Journal of Econometrics* 225(2): 200-230.
[23] Card, D., & Krueger, A. 1994. Minimum wages and employment: A case study of the fast-food industry in New Jersey and Pennsylvania. *American Economic Review, 84,* 772-793.

adjust for these differences and improve precision in our estimates. Logistic regression models will be used to estimate the DID when outcome variables involve binary conditions (e.g., was the nonfatal shooting case cleared through arrest? 0 = No, 1 = Yes). Count regression models (i.e., Poisson and negative binomial) will be used to estimate the DID when outcome variables involve discrete counts of events (e.g., the number of witnesses interviewed). Cox proportional hazards models will be used to estimate the DID when outcomes involve survival data (e.g., time until an arrest).

It is also important to recognize that case investigations will be nested within DPD districts and larger divisions. As such, we must adjust our DID estimators for the varying contextual influences on nonfatal shooting investigation outcomes across DPD administrative units. We will analyze this nested data structure through the inclusion of fixed effects (i.e., a series of dummy variables that express constant effects across DPD units).

"Time to arrest" indicates a strong signal regarding both the intrinsic difficulty of solution and the importance of investigation resources. Research in Boston found that 6% of both fatal and nonfatal cases result in an on-scene arrest and that 11% of both fatal and nonfatal cases have an arrest within two days of the crime.[24] These clearance rates subsequently diverged and increasingly favored the fatal cases with a cumulative 37% clearance rate after 1 year relative to a 19% clearance rate for nonfatal cases. The enhanced investigations by the FAST unit might show cumulative improvements in nonfatal shooting clearance over time that are like the trajectory of fatal cases. Studies that do not consider the longer-term effects of enhanced investigative processes will necessarily be limited when comparing treatment to control conditions. As we will observe case outcomes over 12 years, the research will capture these longer-term treatment effects (if they exist).

The presence of a like comparison group and the extended observation periods will address many threats to the validity of causality claims (e.g., regression to the mean). To further safeguard against additional threats to validity, we will run a placebo test to assess whether any observed effects could have arisen by chance.[25] Burglary clearance rates in Denver should not be influenced to a large degree by the creation of the FAST unit. As such, we will estimate the same

[24] Cook, P. J., Braga, A. A., Turchan, B., & Barao, L. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18, 525 – 552

[25] De Craen, A., Kaptchuk, T., Tijssen, J., & Kleijnen, J. (1999). Placebos and placebo effects in medicine: historical overview. *Journal of the Royal Society of Medicine,* 92, 511–515; Neumayer, E., & Plümper, T. (2017). *Robustness tests for quantitative research.* Cambridge University Press

DID regression models used to assess the effects of the treatment on nonfatal shooting case clearances. If the DID models find a statistically significant improvement in burglary clearance rate in the treatment divisions relative to control divisions, the finding would suggest that an unmeasured confounding factor or perhaps a series of division specific secular trends in the intervention group generated any observed statistically significant increases in shooting clearance cases. In contrast, if the DID models do not detect a statistically significant improvement in burglary clearance rates in the treatment divisions relative to control divisions, the finding would strengthen the case that observed statistically significant increases in shooting cases was attributable to the intervention.

It is possible that clearance rates for cases included in the treatment and control groups could vary during the pre-intervention period. However, violent gun crime events that do and do not involve gunshot injuries share the same underlying characteristics, situations, and dynamics. For instance, research suggests gun robbers select victims based on cursory assessments of risks and rewards.[26] If victims fail to comply and resist, robbers may fire shots. Some gunshots will hit resisting victims (gunshot injury) and some will miss the mark (no gunshot injury). Similarly, interpersonal disputes involving guns may or may not lead to the gun being fired and, if fired, the shots fired may or may not hit the intended victim. The data collection schemes described in the proposal should position our analyses to determine whether there seems to be any resulting differences in clearances and the underlying investigative information (e.g., witness cooperation, forensic testing). We can then make appropriate adjustments to our regression analyses if systematic differences are detected.

The most important issue is whether there are parallel trends in clearance rates for violent gun events where victims suffer a nonfatal gunshot injury relative to violent gun events where victims are not physically injured. The parallel trends assumption, requiring that the difference between treatment group and comparison group is constant over time, is critical to the internal validity of our DID model.[27] We will complete two complementary analyses to determine whether the parallel trends assumption was met. First, we will complete a visual inspection of the estimates and 95% confidence intervals from a regression of clearance rates on the interaction between year dummy variables and treatment / comparison status to determine whether pre-

[26] Cook, P. J. (2009). ‘‘Robbery.’’ Pp. 102-14 in *The Oxford Handbook of Crime and Public Policy*, edited by M. Tonry. New York: Oxford University Press; Wright, R. T. & Decker, S. (1997). *Armed Robbers in Action*. Boston: Northeastern University Press.
[27] Angrist, J. & Pischke, J-S. (2009). *Mostly Harmless Econometrics.* Princeton, NJ: Princeton University Press.

intervention trends were significantly different from zero. Second, we will run a joint F-test of interaction between treatment / comparison status and year dummy variables during the pre-intervention period to determine whether there are any statistically significant differences in trends.

Qualitative Analysis Component of the Impact Evaluation

Qualitative inquiry offers unique and rich insights, as open-ended questions allow respondents to communicate nuanced views that do not necessarily lend themselves to quantitative methods captured in surveys or administrative records. As previously mentioned, several practices have been identified in increasing clearance rates including: the response of investigators within the first two days of the incident (e.g., rapid response to the crime scene and identification of witnesses),[28]standardization of investigative procedures and forensic reviews, peer review of open investigations, and departmental investments in training and technology.[29] Moreover, witness cooperation is particularly crucial in nonfatal shootings, having been cited as a key to success in the vast majority of cleared cases for both Kansas City, MO[30] and Boston, MA.[31]

Based on interviews with command staff and investigators, we will examine the following criteria: the extent of standardization of investigation activities; investigative approaches to gaining victim and witness cooperation; and general insights on how FAST works differently from other investigation efforts. The motivating questions are as follows:

1. How well does the FAST program's investigative practices comport with what is known about "best practices?"
2. What techniques do investigators employ to increase the likelihood of victim cooperation?
3. What techniques do investigators employ to increase the likelihood of witness cooperation?
4. What have investigators learned from unsolved cases? How have they used this to modify their own practices?

[28] Braga, A. A. (July 2021). Improving Police Clearance Rates of Shootings: A Review of the Evidence.
[29] Braga, A. A., & Dusseault, D. (2018). Can homicide detectives improve homicide clearance rates? *Crime & Delinquency*, 64, 283 – 315.
[30] Greenwood, P. W., Chaiken, J. M., & Petersilia, J. (1977). *The investigation process*. Lexington, MA: Lexington Books.
[31] Cook, P. J., Braga, A. A., Turchan, B. S., & Barao, L. M. (2019). Why do gun murders have a higher clearance rate than gunshot assaults? *Criminology & Public Policy*, 18, 525-551.

5. What recommendations would investigators offer at the institutional level to further increase clearance rates based on their success in, and obstacles to, solving cases?

The FAST command staff will be first interviewed for a baseline understanding of what the procedures should entail. They will also be interviewed about their perceptions and assessment of the cases prior to FAST and afterward, lessons learned, and any potential policy recommendations. There may be up to two interviews for each command staff, with the second coming after the investigators' have been concluded for any possible clarification.

All FAST investigators will be invited to interview, but only the ones who consent will be interviewed. Given the chief's support for the study and the command staff's enthusiasm for the FAST unit's work, we anticipate robust participation among investigators. After the interviewer reviews the consent form with each participant, the interviewer will request consent to audio record the interviews and guarantee confidentiality. The interviewer will also take notes. Interviews will be structured and designed to last 60-75 minutes in a private and convenient location for the participant.

To aid in the interview of FAST investigators, we will draw from the 100 randomly selected cases described earlier in the data section. We will read and select three cases per investigator about which to ask them, two of which were cleared and one of which was not.
The beginning of the interview will consist of demographic and other basic warm-up questions, such as years of experience as an officer and, specifically, as an investigator. The next section will ask about procedural matters—to be able to gauge how widespread procedures are that they believe have been standardized. The third section will refer to three specific cases on which they led the investigation. Here, questions will include their recollection of obstacles and what they did to overcome them, lowlights, surprises, and lessons learned. Questions will focus in on each investigator's techniques for gaining cooperation from victims and witnesses, what has seemed to work and not work, and advice they would offer to other investigators? The last section of the interview will be geared toward broader policy recommendations. Questions will begin with the individual philosophies as investigators (e.g., what motivates them) and their approach to decision-making on a case. This section of the interview will include the investigators assessments of differences between investigating nonfatal shootings before FAST compared to the present, and conclude with their recommendations for improving clearance rates.

Up to five prosecutors who handle non-fatal shooting cases also will be interviewed for 60-75 minutes in a private and convenient setting (with the same consent and confidentiality protocols observed for investigators). The purpose of this interview is to deepen the assessment of the extent of standardization in investigations. Similar to FAST command staff, prosecutors will be asked about their understanding of FAST investigators' practices, perceptions of how nonfatal shooting investigations were handled previously compared to after the implementation of the FAST program, and suggestions for further strengthening of the program.

We will contract professionals to transcribe the interviews, after which we will conduct quality controls and code using NVivo software to identify themes.

Potential Impact

1. Improved Understanding of How to Solve Shooting Cases

This project will document the production function for solving shooting cases, by (1) testing the proposition that extra police resources matter for non-fatal shooting investigations, (2) enhancing our understanding of the role of the victim in shaping investigations, and (3) quantifying the impact of prioritizing non-fatal shooting investigations on clearance rates.

2. Potential for Improved Clearance Rates in Denver

Because this project involves applied research working directly with the DPD, it has the potential to impact the city's resource allocation decisions, which may have significant consequences for the residents of Denver. By providing a template for how to improve clearance rates for shootings, these departments may be able to build public trust, and improve public safety by disrupting cycles of retaliatory violence.

3. Potential for Improved Clearance Rates Nationally

Beyond Denver, this research has the potential to inform how other jurisdictions staff and equip their non-fatal shooting detective units. Historically, the workload of detectives investigating non-fatal shootings has been far higher than those investigating murders, and in many large cities, a significant share of non-fatal shootings are not even assigned a detective.[32] By studying the benefits of allocating investigative resources towards non-fatal shootings, this project has the

[32] https://www.thetrace.org/2019/01/gun-murder-solve-rate-understaffed-police-data-analysis/

potential to provide a valuable foundation for police departments across the U.S., particularly those focused on improving their clearance rates for serious gun crimes.

Denver as a Potentially Influential Research Site

We believe that an evaluation of DPD's FAST will attract considerable interest nationwide. Our impression from speaking to the leadership of other departments, is that the program is already widely known. In part, that is because FAST is a promising innovation for gun violence prevention at a time when most of the larger cities are dealing with a surge in gun violence. It helps that the Denver PD has a good reputation as an innovative department.

Denver is an attractive setting as representing the fast-growing Southwest. Its population of 727 thousand is diverse with respect to race and ethnicity: 55% non-Hispanic White, 30% Hispanic, 10% Black, 4% Asian, 3.5% multiracial, and 1.8% Native American.[33] This diversity poses challenges and opportunities that come with DPD's stated goals of equitable and culturally responsive policing. Notably, Denver has spent the last 20 years as either an early adopter or innovator of progressive policing practices and reforms,[34] often garnering recognition from other jurisdictions nationally. Yet, Denver is understudied relative to its importance. Because of the pride the Denver Police Department takes in its mission to innovate,[35] it has a history of cooperating with researchers to measure programmatic impact.

Here's one telling example. Since 2002, DPD has implemented Crisis Intervention Team (CIT) training for officers[36] to understand the various reasons people could be experiencing crisis and de-escalate situations in ways that avoid unnecessary injury or fatalities as well as connect individuals to appropriate services. In 2004, following a tragic officer-involved shooting of a minor, DPD instituted CIT training for all academy cadets and half of the patrol force (so that each shift at every police district had CIT-trained officers available).[37] Denver has sought to further improve its response to mental health crises with its Support Team Assistance Response

[33] https://www.census.gov/quickfacts/denvercountycolorado
[34] https://www.denvergov.org/files/assets/public/police-department/documents/progressive-policing/alternative-response.pdf
[35] https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Police-Department
[36] https://www.nami.org/Advocacy/Crisis-Intervention/Crisis-Intervention-Team-(CIT)-Programs
[37] Finnegan, C. (2004, June 8). A letter from the City of Denver to Helen Childs (Mother of 15 year-old Paul Childs, killed by a Denver police officer). *Rocky Mountain News.* https://la.utexas.edu/users/jmciver/357L/P5/RMN_Letter%20from%20the%20City%20of%20Denver%20to%20Helen%20Childs_060804.htm

(STAR) program piloted June 1-Dec 1 in 2020. In this "community responder" model, a mental health clinician and paramedic in a "specially equipped van" may either be dispatched by 911 agents to support individuals or be called directly by officers who recognize them as better suited to resolve the situation. Findings from a quasi-experimental study published in *Science Advances* showed the program reduced certain low-level offenses in treated precincts by 34%, both because incidents were less likely to be recorded as crimes subject to arrest or citation and because there were actual reductions in crime.[38] The Mayor has proposed to expand the program and add 10 new employees in his 2023 budget currently awaiting approval by City Council.[39]

The City and Police Department have a commendable capacity to learn from mistakes. In 2005, a civilian oversight agency called the Office of the Independent Monitor (OIM)[40] was formed through a combination of the popular vote and decisions by the Mayor and City Council to provide additional transparency and accountability with respect to Denver's police, sheriff, and fire departments. The OIM both monitors and is involved in investigating civilian-generated complaints, internally generated complaints, and critical incidents (meaning serious bodily injury or death to a civilian involving sworn police officers and sheriff deputies, including suicides in custody). The OIM oversees timeliness and quality of complaint investigations and the reasonableness of findings and discipline imposed, makes recommendations regarding training and policy matters, and issues public reports. DPD's Internal Affairs Bureau partners with the OIM to refer complaints deemed appropriate for mediation (subject to consent by the complainant and officer).[41] Here, professional mediators facilitate face-to-face discussions between the parties in a neutral setting. After nearly 300 mediations, Denver's mediation program was shown to significantly increase satisfaction over the traditional complaint process for civilians and officers.[42] This mediation program became one of the nation's largest, and DPD jointly promoted the program to other police departments in national conferences,[43] such as the International Association of Chiefs of Police conference that took place in Denver in 2009.

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[38] Dee, T., & Pyne, J. (2022). A community response approach to mental health and substance abuse crises reduced crime. *Science Advances*, 8 (23): https://doi.org/10.1126/sciadv.abm2106

[39] https://www.denverpost.com/2022/10/05/bucking-defunding-police-calls-record-amount-police-fire-jail/

[40] https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Office-of-the-Independent-Monitor

[41] https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directory/Office-of-the-Independent-Monitor/Mediation-Program

[42] Schaible, L. M., Angelis, J. D., Wolf, B., & Rosenthal, R. (2013). Denver's Citizen/Police Complaint Mediation Program: Officer and Complainant Satisfaction. *Criminal Justice Policy Review*, *24*(5), 626–650; Clemmons, A., & Rosenthal, R. Mediating citizen complaints: The Denver program. *The Police Chief*, 75 (8):32 – 36.

[43] https://www.uticaod.com/story/news/columns/2011/01/07/denver-program-serves-as-model/45084903007/

Today, the OIM has more than doubled its staff from six to 13. Even in a recent example of DPD's openness to examination, it released a statement[44] agreeing to implement several recommendations posed by the OIM after its review of how police responded to George Floyd protests in 2020.

We believe that Denver PD has earned its high standing with other departments across the country, and that a high-quality evaluation will have national impact.

[44] https://storymaps.arcgis.com/stories/d25ae76545014a8f9cf3392b4946f682