The Unexpected Consequences of Automation in Policing

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THE UNEXPECTED CONSEQUENCES OF AUTOMATION IN POLICING

Elizabeth E. Joh*

ABSTRACT

This Article has two aims. First, it explains how automated decision-making can produce unexpected results. This is a problem long understood in the field of industrial organization, but identifying its effects in policing is no easy task. The police are a notoriously difficult institution to study. They are insular, dislike outsiders, and especially dislike critical outsiders. Fortunately, we have the benefit of a decade’s worth of experimentation in police use of automated decision-making and the resulting political backlash against some of these uses. As a result, some large urban police departments have undergone external investigations to see whether tools like predictive policing or individual criminal risk assessments are biased, ineffective, or simply too costly despite their benefits. One of these recent reports, studying the use of acoustic gunshot detection software in Chicago, provides a window into one type of police automation.

This leads to the Article’s second observation. Automation is not just a set of tools that the police use; it changes the environment of policing in unexpected ways. The increasing use of automated tools in policing has generated some widely shared criticisms, but they focus primarily on the flaws of the technologies used. The training data in facial recognition algorithms may be biased along lines of race, gender, and ethnicity. Risk assessments for gun violence may, in truth, be poor guides for police intervention. These claims are singularly technology-focused. Accordingly, errors and inefficiencies merit technological improvements. Even calls for bans on technologies like facial recognition are responses to the technology itself. As Chicago’s experience with acoustic gunshot detection technology demonstrates, however, automation serves not just as a tool for the police, but also leads to changes in police behavior. These changes in police conduct are documented in a 2021 report from the Chicago Office of Inspector General, and they are noteworthy. If automation unexpectedly changes police behaviors, these changes have implications for how we understand policing through the lens of inequality and unaccountability.

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AUTOMATED decisions are a big part of police work today. The conventional model underlying automation works something like this: if a machine provides insight about crime, the police apply that knowledge in their decision about where to go and what to do. But it would be surprising if automation worked that smoothly in practice. Human beings aren’t generally known for their perfect compliance and obedience, and police officers are no exception. Deviating from expectations about how humans use machines can provide creative solutions or create new problems. What happens when police use automation in unexpected ways?

Raising this question matters. Two very different forces shape American policing today. One, arising from the national protests surrounding George Floyd’s murder in 2020,1 highlights longstanding issues of racial discrimination, unaccountability, and inequality in policing with renewed urgency. Darnella Frazier’s decision to record Floyd’s death and post the video on Facebook made real the disproportionate share of state violence shouldered by Black Americans.2 A 2021 study published in the medical journal The Lancet described this burden in stark terms.3 Researchers estimated more than 30,000 Americans died as a result of police violence between 1980 and 2018,4 and Black Americans were 3.5 times more likely

4. Id. at 1239.
to be killed by the police than Whites during that time period.⁵

The other important development is the increasing use of technologies that collect and analyze massive amounts of information. Tools like predictive policing software, risk assessment instruments, and facial recognition technologies are reshaping the structures of institutions throughout society. We see different labels for these developments, including algorithms, artificial intelligence (AI), big data, and automation. All rely on three developments: the ability to collect and store massive amounts of data easily and cheaply, an increase in computing power, and the development of software that analyzes and processes that data with varying degrees of sophistication.⁶

The term automation is broad enough to include all these developments. In this Article, automation refers to delegating to computers aspects of decision-making previously assumed only by people.⁷ Some outcomes of automation bring clear benefits, such as voice transcription to help the disabled⁸ or recommendation algorithms that enhance people’s enjoyment of books, music, and films.⁹ But other changes have life-altering impacts, such as whether a person is deemed hirable or creditworthy.¹⁰ Police forces’ growing reliance on automation falls into

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⁵ Id. at 1247 (“The police have disproportionately killed Black people at a rate of 3.5 times higher than White people, and have killed Hispanic and Indigenous people disproportionately as well.”); see also Frank Edwards, Hedwig Lee & Michael Esposito, Risk of Being Killed by Police Use of Force in the United States by Age, Race-Ethnicity, and Sex, 116 PROC. NAT’L ACADEMY OF SCI. 16793, 16793 (2019) (finding risk of fatal police violence highest for black men, who face “about a 1 in 1,000 chance of being killed by police”).


⁷ Certainly some discussions require disentangling machine learning from more straightforward algorithms applied to historical data. See, e.g., David Lehr & Paul Ohm, Playing with the Data: What Legal Scholars Should Learn About Machine Learning, 51 U.C. DAVIS L. REV. 653, 660–62 (2017) (arguing that Fourth Amendment scholarship on big data and machine learning erroneously treats machine learning as a “fully formed black box” and “neglects the intricate processes of machine learning”). Because this Article focuses on the social and legal implications of unexpected human uses of automated processes, however, the broad use of automation is sufficient here.


⁹ See, e.g., How Netflix’s Recommendations System Works, NETFLIX, https://help.netflix.com/en/node/100639?ba=SwiftypeResult Click&q=recommendations%20system [https://perma.cc/TTX2-AUY9] (“We take feedback from every visit to the Netflix service and continually re-train our algorithms with those signals to . . . provide you with a product that brings you joy.”).

This Article has two aims. First, it explains how automated decision-making can produce unexpected results. This is a problem long understood in the field of industrial organization, but identifying its effects in policing is no easy task. The police are a notoriously difficult institution to study. Fortunately, we have the benefit of a decade’s worth of experimentation in police use of automated decision-making and the resulting political backlash against some of these uses. As a result, some large urban police departments have undergone external investigations to see whether tools like predictive policing or individual criminal risk assessments are biased, ineffective, or simply too costly despite their benefits. One of these recent reports, studying the use of acoustic gunshot detection software in Chicago, provides a window into one type of police automation.

This leads to the Article’s second observation. Automation is not just a set of tools that the police use; it changes the environment of policing in unexpected ways. The increasing use of automated tools in policing has generated some widely shared criticisms, but they focus primarily on the flaws of the technologies used. For example, the training data in facial recognition algorithms may be biased along lines of race, gender, and ethnicity. Risk assessments for gun violence may, in truth, be poor guides for police intervention. These claims are singularly technology-focused. Accordingly, errors and inefficiencies merit technological improvements. Even calls for bans on technologies like facial recognition are responses to the technology itself. As Chicago’s experience with acoustic gunshot detection technology demonstrates, however, automation serves not just as a tool for the police but also leads to changes in police behavior. These changes in police conduct are documented in a

15. Infra Part III.
17. See generally CITY OF CHI. OFF. OF INSPECTOR GEN., ADVISORY CONCERNING THE CHICAGO POLICE DEPARTMENT’S PREDICTIVE RISK MODELS 5 (2020) (outlining the pertinent information missing from the CPD’s risk assessments).
2021 report from the Chicago Office of Inspector General (OIG), and they are noteworthy. If automation unexpectedly changes police behaviors, these changes have implications for how we understand policing through the lens of inequality and unaccountability.

II. AUTOMATION’S EFFECTS

The increasing use of technologies to capture, store, and analyze every movement, click, post, and transaction has become a conventional part of ordinary policing. Whether labeled as AI or big data, these new technologies of surveillance and investigation give the police capabilities unimaginable a generation ago. Predictive policing software identifies persons and places associated with a high risk of criminality. License plate reader systems capture and store millions of plate scans that allow individualized tracking of people. Private and public sources feed millions of faces every day into databases that are scanned by law enforcement agencies. Both mass aerial surveillance planes and autonomous drones can capture images useful for investigations. The scope of these technologies is enormous and includes details like our faces and driving patterns. One report estimates that, as of 2016, one in two American adults has a picture stored in a facial recognition network. One of the largest vendors of license plate reader data boasts that its database, accessible to law enforcement, has more than nine billion license plate scans—more than thirty for every registered vehicle driven today.

18. See infra Part III.
23. See, e.g., Diaz & Levinson-Waldman, supra note 20.
Although these technologies represent enormous leaps of scale and capability, they also have continuities with past practices. Surveillance is an essential aspect of modern society. Policing, in particular, has always needed methods of collecting, sorting, and deriving insights from information. What is distinctive about today’s automation, however, is its ease, breadth, and depth. Whether collected directly or indirectly by the police, data can be captured easily, kept indefinitely, and assessed repeatedly. Not only do these new tools permit the police to collect and assess data about individuals and populations, they do so with low effort. Neither facial recognition software nor license plate readers need human intervention. Their automated matches are routinized and automatic.

Earlier studies on automation can provide a great deal of insight here. We know that the introduction of automated systems into any field can bring “unanticipated problems and failures.” A key observation from the field of industrial organization is that technology cannot be understood in isolation from the people tasked with using it. This is true of airline pilots as well as factory machine operators. When automated processes arrive in the workplace, a common misunderstanding is that these tools will increase speed and efficiency but will otherwise leave other systems and actors unaffected. This “substitution myth” is not borne out in reality. Automation brings with it transformative changes.

Sometimes unintended consequences occur in automation because there is a gap between how the developers envision people using their systems and how the systems work in real life. Automating processes can lead to changes that are “qualitative and context-dependent” in the workplace. For example, early autopilot programs revealed some surprises. Developers designed the systems to improve safety by having ma-


28. See Sarah Brayne, Big Data Surveillance: The Case of Policing, 82 Am. Socio. Rev. 977, 979 (2017) (“Whereas traditional surveillance is inductive, involving the ‘close observation, especially of a suspected person,’ . . . and relying on the unaided senses, new surveillance is more likely to be applied categorically, deductive, remote, low visibility or invisible, involuntary, automated, preemptive, and embedded into routine activity.”).


31. See Sarter, Woods & Billings, supra note 29, at 1 (“The assumption was that new automation can be substituted for human action without any larger impact on the system in which that action or task occurs, except on output.”).

32. Id.

33. See id. at 2.

34. Id. at 3.
machines assume some of a pilot’s tasks, but their designs did not always take into account how pilots might interact with their machines. New machines introduced complexity by requiring tasks that pilots had not performed before. Pilots did not understand some of the new processes and thus ignored them as a result. Automated flight deck systems may not work as intended if they do not take into account actual air traffic control patterns and pilots’ varying preferences. Automation in flight was not merely a substitute for the work of a human being; it changed the process of flying a plane and the pilots themselves in unexpected ways.

Also relevant here is the repeated observation that we all rely heavily on mental shortcuts. We lean on strategies to simplify our decision-making rather than engage in full and thorough assessments. Without these simplifications, even ordinary decision-making would be exhausting. In terms of social psychology, we are “cognitive misers.” When confronted with complex problems, people tend to adopt cognitive shortcuts that emphasize efficiency, even if these solutions are incorrect, biased, or less than optimal. The result is that our decision-making processes favor simplicity over comprehensiveness and speed over reflection. Legal scholars have used the cognitive miser framework to help explain recurring but troubling instances of decision-making, including how racial bias can influence decisions about force and suspicion.

In short, policing itself is being transformed by processes that have not just expanded the surveillance capabilities of the police but have automated many processes once considered essentially human, like judgments about suspicion and recognition of persons. We also know that automation does not simply lighten work burdens by substituting machines for human labor. Automation can produce surprising and sometimes unwanted effects. This means that people may face new and unexpected complexities when automation enters their workplace. When confronted with complex systems of automation, we can reasonably expect people to take mental shortcuts to make quick decisions in the ways they always have. The results may be surprising, novel, and complicated in unanticipated ways.

35. See id. at 1.
36. See id.
37. See id. at 4.
38. See id. at 2.
41. See id.
42. See, e.g., L. Song Richardson & Phillip Atiba Goff, Self-Defense and the Suspicion Heuristic, 98 Iowa L. Rev. 293, 298–314 (2012) (describing how misleading mental shortcuts can produce “suspicion heuristics”: intuitive judgments about criminality or threats that also lead to racially biased perceptions).
III. AUTOMATION’S EFFECTS ON POLICING: SHOTSPOTTER

Police behavior is notoriously difficult to study. As an occupational group, police are insular and distrustful of outsiders—especially critical outsiders.\(^{43}\) Thus, whether and how automation works in policing will likely be a difficult topic to study. With police automation, oversight mechanisms have achieved some transparency. A handful of large, urban police departments have undergone reviews by local inspectors general.\(^{44}\) This Part reviews the findings of Chicago’s experience with acoustic gunshot technology, as evaluated by the Chicago Inspector General in 2020.

A. CHICAGO, POLICE, AND SHOTSPOTTER

Violent crime and racially disparate policing have been a persistent problem in Chicago for more than fifty years, although its realities are somewhat different than national headlines imply.\(^{45}\) Chicago does not lead the nation in murder, as some have suggested.\(^{46}\) But while crime rates fell in Chicago (and in other major American cities) from the 1990s to the 2010s, violent crime remains a problem.\(^{47}\)

Crime is not evenly distributed across all communities.\(^{48}\) Instead, crime visits neighborhoods of “concentrated” violence in Chicago: places where violence is matched by entrenched “forms of disadvantage, from poverty to segregation, to joblessness.”\(^{49}\) Low-income, majority-Black neighborhoods experience disproportionately higher rates of homicide in Chicago than their wealthier, Whiter counterparts.\(^{50}\) As sociologist Patrick Sharkey has observed of Chicago, “[t]he overall level of violence has fluc-

\(^{43}\). See, e.g., THE ENCYCLOPEDIA OF POLICE SCIENCE, supra note 13, at 997 (“As an outsider group, the patrol officers’ occupational identity and subculture crystallize, wherein isolationism, secrecy, strong in-group loyalties, sacred symbols, common language, and a profound estrangement from the larger society intensify.”); cf. Richard V. Ericson, Patrolling the Facts: Secrecy and Publicity in Police Work, 40 BRIT. J. SOCIO. 205, 211 (1989) (“The police have a particular bent toward reticence and secrecy.”).


\(^{48}\). See id. at 349.

\(^{49}\). Id. (citations omitted).

The police in Chicago have tried many different approaches. In 1992, the city council adopted the Gang Congregation Ordinance in response to rising rates of murder and violent crime. The ordinance permitted officers to arrest individuals who failed to disperse after the police identified them as “criminal street gang members” loitering in a public place “with no apparent purpose.” In 1999, the U.S. Supreme Court struck down the city’s Gang Congregation Ordinance. The Court acknowledged that the ordinance was designed to address illegal drug sales and intimidation of city residents by gang members, but it nevertheless “afford[ed] too much discretion to the police and too little notice to citizens who wish to use the public streets.” Though the initial ordinance was deemed unconstitutionally vague, the city council passed a new ordinance in 2000 that addressed the Court’s concerns.

Fast forward a few decades and we can see that the tools used by the Chicago police, like police everywhere, are considerably different. In 2018, the city of Chicago entered into a three-year, thirty-three million dollar contract for services with an acoustic gunshot detection technology company called ShotSpotter. Like many technological tools used today by the police, the relationship between the Chicago Police and ShotSpotter is that of customer-vendor. In theory, acoustic gunshot technology is designed to help police identify more gun incidents and respond to them more quickly. Research suggests that gun violence is severely underreported. Thus, acoustic gunshot detection technology is intended to

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51. Sharkey & Marstellar, supra note 47, at 361. Regarding increasing violent crime rates since the 2010s, Sharkey finds, “The overall increase in murders between 2014 and 2020 has disproportionately affected Black residents.” Id. at 370.
53. See id. at 50–51 (1999).
54. Id. at 64.
identify many more incidents for police response that would otherwise go unreported.

ShotSpotter describes its technology as having “automated the process” of identifying gunshots.60 Its service uses both mounted hardware in public spaces and AI at its corporate offices.61 The company’s acoustic sensors, placed throughout a city, listen for gunshots.62 Any potential gunshot sound is transmitted from the sensors to ShotSpotter, where machine learning algorithms classify the sound.63 ShotSpotter’s human analysts are then supposed to either reject or confirm the identified sounds as gunshots and not, for instance, fireworks.64 An alert confirming that a probable gunshot has been detected is then sent to the client’s police department in a minute or less.65

More than a hundred cities in the United States have entered into contracts with the publicly-traded company for these services.66 The subscription fees ShotSpotter charges cities for its services range from $65,000 to $95,000 per square mile per year.67 These commercial relationships typify the growing police reliance on private sector tools that local governments neither use nor completely control.68 ShotSpotter contracts often state that the firm, not the municipal customer, owns the data.69 The company also claims that the data it generates from its acoustic gunshot sensors are proprietary trade secrets.70 This corporate secrecy has made it difficult to access the data supporting the company’s claims.71
In Chicago, gunshots detected by ShotSpotter display as alerts on the ShotSpotter application available to employees of the Office of Emergency Management and Communications (OEMC), analysts at the police department’s Strategic Decision Support Centers, and on-duty officers who have the ShotSpotter mobile app on their work-issued smartphones.72 Chicago Police Directives instruct officers responding to ShotSpotter alerts to look for victims, evidence of a crime, or any potential suspects at the scene.73

Every single ShotSpotter alert becomes a data point. Chicago OEMC employees assign a unique number for each alert and then dispatch officers to respond.74 After officers respond to the alert, the primary police unit is required to report the outcome to the OEMC.75 The disposition code assigned to the outcome of the case depends on whether the event is considered a criminal incident or a non-criminal one.76 Chicago Police Directives also require that officers who conduct investigatory stops in response to a ShotSpotter alert record that unique event number as part of the stop’s recorded information.77 All this coding means that ShotSpotter alerts themselves become recorded data that can be aggregated and analyzed, as well as cross-referenced with other records like police stops and arrests that may be related.78

In 2021, the Public Safety section of the Chicago OIG began an inquiry into the Chicago Police Department’s (CPD) use of ShotSpotter technology.79 Its investigation focused on all ShotSpotter alert notifications between January 1, 2020, and May 31, 2021, as well as all investigatory stops associated with a ShotSpotter alert within the police department’s cross-referencing system.80 The OIG’s final report, issued in August 2021, provided both a quantitative and qualitative analysis of the department’s ShotSpotter use.81

The sheer number of alerts generated by ShotSpotter is noteworthy. During the seventeen-month period under review, the OIG identified a total of 50,176 ShotSpotter alerts as “probable gunshots” with unique identifier numbers.82 Every single one of these alerts resulted in a police response to the location identified by the company’s alerts.83 The OIG also found 1,056 police investigative stops associated with ShotSpotter

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73. See id. at 8.
74. See id. at 2–3.
75. See id. at 9.
76. See id.
77. See id. at 11.
78. See id.
79. See id. at 2.
80. See id.
81. See id.
82. Id. at 2–3.
83. Id.
alerts, as illustrated in Figure 1. In other words, the required documentation associated with these stops shared event numbers with particular ShotSpotter alerts.

Also notable is the geographic distribution of alerts. Almost a quarter of all alerts—11,903 unique events—were concentrated in two CPD districts: the Fourth and Fifth. These areas, located in the south and southeastern portions of the city, also coincide with neighborhoods that are both low-income and majority Black or Hispanic. Other analyses have suggested that ShotSpotter sensors tend to be concentrated in urban communities of color rather than distributed evenly throughout a city.

Figure 1: Narcotics Arrest Following Response to ShotSpotter Alert

The Chicago OIG’s assessment of the police department’s use of acoustic gunshot detection technology is withering. Out of the total number of alerts, Chicago police officers found evidence of gun-related criminal of-

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84. Id. at 3.
85. Id.
86. Id. at 13. The current boundaries of the Fourth and Fifth police districts can be found at Boundaries—Police Districts (current), CHI DATA PORTAL, https://data.cityofchicago.org/Public-Safety/Boundaries-Police-Districts-current-/fthy-xz3r [https://perma.cc/3SM6-VMB8].
88. See Todd Feathers, Gunshot-Detecting Tech Is Summoning Armed Police to Black Neighborhoods, VICE (July 19, 2021, 9:17 AM), https://www.vice.com/en/article/88nd3z/gunshot-detecting-tech-is-summoning-armed-police-to-black-neighborhoods [https://perma.cc/H7V3-3VZJ] (finding that in Chicago, Kansas City, Cleveland, and Atlanta, “the data shows that the sensors are also placed almost exclusively in majority Black and brown neighborhoods, based on population data from the U.S. Census”).
89. OIG Report, supra note 14, at 18. “A/O’s” refers to arresting officers.
fenses just 4,556 times—representing only 9.1% of all police responses to ShotSpotter alerts during the review period. In addition, just 1,056 investigatory stops were associated with unique ShotSpotter event numbers, representing a mere 2.1% of all police responses to ShotSpotter alerts. The OIG summarized its finding: “CPD responses to ShotSpotter alerts rarely produce documented evidence of a gun-related crime, investigatory stop, or recovery of a firearm.” Police use of ShotSpotter in Chicago “had no significant impact on firearm-related homicides or arrest outcomes.”

While gunshot detection technology offers the theoretical benefit of quicker police response times and more efficient law enforcement, the OIG report on its use in Chicago raises the stark question of whether the tool is justifiable. The very existence of the technology has costs, including the “financial resources, the time and attention of CPD members, and the risk that CPD members dispatched as a result of a ShotSpotter alert may respond to incidents with little contextual information about what they will find there.” The report did not have any immediate effect. When the Chicago OIG published its findings, the CPD had already exercised its option to extend its original $33 million contract with the company. The new contract expires on August 19, 2023.

Media coverage of the OIG report focused on the unproven efficacy of the technology. News outlets said the Chicago OIG’s “scathing report” revealed that the Chicago Police had adopted an expensive, “ineffective tool.” The report’s findings were similar to a May 2021 analysis of Chicago’s ShotSpotter use conducted by the MacArthur Justice Center at Northwestern Pritzker School of Law. The MacArthur study analyzed a slightly different time period—July 1, 2019, to April 13, 2021—but came to a similar conclusion. In their review of data obtained from Chicago’s OEMC, of the 46,743 police responses prompted by a ShotSpotter alert during the review period, the vast majority—85.6%—yielded no evidence

90. See id. at 3.
91. Id.
92. Id.
93. Id.
94. Id. at 6.
95. Id. at 22.
96. Id. at 2.
97. Id.
of a crime or any other reportable incident by the responding officers. These “dead-end” responses by the police were not evenly distributed across the city. By matching the locations of ShotSpotter alerts with census data, the MacArthur Justice Center found that, during its review period, the technology was “deployed in the [twelve] districts with the highest proportion of Black and Latinx residents and the lowest proportion of White residents.”

ShotSpotter’s response to the Chicago OIG report is founded on a claim it has made before: its official statement reported that “[t]he OIG report does not negatively reflect on ShotSpotter’s accuracy which has been independently audited at 97[%] based on feedback from more than 120 customers.” ShotSpotter claims that its technology can identify gunshots with “97% accuracy,” but the company does not offer evidence from independent studies to support this claim. Nor has the company’s proprietary algorithm ever been peer-reviewed by independent researchers. A 2011 investigation by ShotSpotter found that the technology can both miss gunfire close to its sensors and produce false positives by misclassifying sounds like backfiring cars and fireworks as gunshots.

Even if the technology was accurate, its ability to reduce gun violence is unclear. ShotSpotter itself claims that its product leads to increases

101. See id. at 10. The Report also found that an even smaller percentage—10.28%—of all ShotSpotter alerts during the period resulted in police reporting an incident about a firearm. Id. According to the report, “[t]he difference between these two figures reflect incidents where police respond to a ShotSpotter alert but end up stumbling upon some other reportable incident.” Id.

102. See id. at 4, 12–16 (“In reality, the ShotSpotter system produces an astonishing number of dead ends: alerts of gunfire that turn up no evidence of gunfire, according to the police’s own classification of each incident.”).

103. Id. at 13–14.

104. WGN Web Desk & Davis, supra note 57.

105. See About ShotSpotter, SHOTSPOTTER, https://www.shotspotter.com/company [https://perma.cc/S4CQ-2Y56] (claiming “97% Accuracy (aggregate across all customers 2019–2020”); see MacArthur Report, supra note 87, at 4 (“The company has never provided validated studies to back up its astonishing claim of ‘97% accuracy’ or 0.5% false positives.”); see also Todd Feathers, Police Are Telling ShotSpotter to Alter Evidence From Gunshot-Detecting AI, VICE (July 26, 2021, 8:00 AM), https://www.vice.com/en/article/qj8xbq/police-are-telling-shotspotter-to-alter-evidence-from-gunshot-detecting-ai [https://perma.cc/LR7B-AUMD] (quoting a ShotSpotter employee’s court testimony about the accuracy rate as “put together by our sales and marketing department, not our engineers”); Are Gunshot-Detecting Microphones Worth the Money?, ECONOMIST (Dec. 4, 2021), https://www.economist.com/united-states/2021/12/04/are-gunshot-detecting-microphones-worth-the-money [https://perma.cc/S46F-CKEF] (observing of ShotSpotter that “there is little independent evidence that it reduces crime overall”).

106. See AP Report, supra note 56.


in arrests and reductions in violence, but these claims are not based on peer-reviewed studies. By contrast, researchers in 2022 examined ShotSpotter uses in sixty-eight large counties from 1999 to 2016 and found no difference in homicides, murder arrests, and weapons arrests between those large metropolitan counties that used the technology and those that did not.

Even more troubling are reported cases in which ShotSpotter’s own analysts have testified in court that they reclassified sounds as gunshots at the request of their police customers—a practice that one employee said “happens all the time.” A reclassified ShotSpotter alert was the key evidence police relied upon to arrest Michael Williams in 2021. Williams told the police that someone in another car shot at him after he picked up an acquaintance in the South Side neighborhood of Chicago on May 31. The bullet hit the car’s passenger, who died two days later. The state’s case against Williams hinged mainly on a ShotSpotter alert identifying a shooting at the intersection where the victim had been shot. Prosecutors interpreted this alert, along with a surveillance video of Williams running a red light, to mean that Williams had shot the victim. Evidence from the pretrial hearing showed that the ShotSpotter algorithm had identified the noise as a firework with 98% confidence. A company employee relabeled the noise as a gunshot. A judge ultimately dismissed the case because of insufficient evidence, but not before Williams spent eleven months in jail.

These findings on the results of CPD’s ShotSpotter use are important. They caution skepticism toward this expensive policing technology—one that might fall well short of its promises about reducing violence and improving police responses. But more broadly, these findings contribute to

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111. See AP Report, supra note 56 (reporting testimony of ShotSpotter engineer Paul Greene in 2016 New York state case).
112. See id. The following facts are taken from the AP investigation.
113. See id.
114. See id.
115. See id.
116. See id.
117. See id. Throughout that weekend, some people in Chicago used fireworks in protests responding to George Floyd’s murder. See Feathers, supra note 105.
118. See AP Report, supra note 56.
119. See id. ShotSpotter issued a lengthy response to the AP and asserted that “the injustices borne from this incident will only be perpetuated if lies are permitted to cover up the facts.” See ShotSpotter’s Response to Associated Press Article, SHOTSPOTTER (Aug. 26, 2021), https://www.shotspotter.com/law-enforcement/shotspotter-response-to-associated-press-article [https://perma.cc/3ZJD-ZDUG].
a growing body of scholarship and activism that questions the implementation of “tech solutionism” to address complex structural problems of violence, poverty, and disadvantage that no single technological tool can solve.120

B. ShotSpotter’s Automation Surprise

Another observation in the Chicago OIG review of Shotspotter’s technology drew less attention but was equally important. Although the OIG report was able to match ShotSpotter alerts to 1,056 stops conducted by the police because they shared the same event number, the report also found some unanticipated information. This Section describes these findings that are buried in the database of police stop reports and explains their importance in the growing automation of policing.

1. Terry Stops and Investigative Stop Reports in Chicago

If police officers have a “reasonable, articulable suspicion that criminal activity is afoot,”121 they may temporarily detain an individual through a Terry stop.122 Every Chicago police officer who conducts a Terry stop must complete an investigative stop report (ISR).123 The ISR includes details about the person stopped and the facts supporting the officer’s reasonable suspicion.124 Officers must also include the relevant ShotSpotter event number when one is associated with the stop.125 This system permitted the OIG to query the Chicago ISR database to find event numbers matching the ShotSpotter alerts identified during the review period.126

In theory, every police stop in Chicago must produce a recorded narrative about the encounter. The OIG searched the narratives of the ISR database to see if other nonstandard information could be discovered

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122. In Terry v. Ohio, the Supreme Court articulated the standard for brief investigatory detentions. 392 U.S. 1, 30–31 (1968).

123. See OIG Report, supra note 14, at 11.


125. See OIG Report, supra note 14, at 11.

126. See id.
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about ShotSpotter use. By searching for the terms “SPOTTER” or “SST,” the OIG found an additional 1,366 ISRs that did not match any of the more than 50,000 ShotSpotter event numbers during the review period. The OIG reviewed a sample of this other set of police stop narratives—72 of the 1,366—for further review.

Some portion of these reports were likely due to recordkeeping issues. Based on their review of these nonstandard references to ShotSpotter, the OIG found that approximately 18% of the seventy-two reports sampled could in fact be traced to an existing ShotSpotter alert. These were stops that should have been initially cross-referenced with an existing ShotSpotter alert but were not, either out of inadvertence or otherwise. But another set of these reports reveal an unexpected pattern that mere quantitative analysis of the official ShotSpotter reports would have missed.

2. “Changing Police Behavior”

Among the seventy-two randomly sampled stop reports that did not match known ShotSpotter alerts but did refer to the technology, the OIG identified ten reports where police officers referred to the “aggregate results of the ShotSpotter system as informing their decision to initiate a stop or their course of action during the stop, even when they were not responding to a specific ShotSpotter alert.” In other words, some police officers justified stop and frisks not because they were responding to a specific alert, but because they were in an area they believed to be the site of previous alerts.

For example, one ISR referred not to a specific ShotSpotter alert but more generally to “multiple bonafide [sic] ShotSpotter events in the area” where the individual stopped had been observed as part of the basis for the stop.

127. See id. at 11–12.
128. See id. at 12.
129. See id.
130. See id. at 19.
131. See id.
132. Figure 2, infra note 133.
Other reports also relied on “ShotSpotter results in the aggregate” to justify frisks of the persons who had been stopped.134 One officer justified an investigatory stop in part because of being “on patrol in an area known for its high volume of ShotSpotter notifications.”135 Another officer justified a frisk of an individual in part “due to many ShotSpotter alerts . . . in the proximity,” leading him to “reasonably believe[ ]” that a large weighted object in the subject’s front hoodie pocket was possibly a firearm.136 Only one of the ten sampled reports that reference ShotSpotter as a general justification, not tied to a particular alert, resulted in an arrest.137

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133. OIG Report, supra note 14, at 20 [hereinafter Figure 2].
134. Id. at 19.
135. Figure 3, infra note 138.
136. Figure 4, infra note 139.
137. See OIG Report, supra note 14, at 19 (referring to the report reproduced as Figure 2).

Figure 3: “In an area known for its high volume of ShotSpotter Notifications”138

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138. Id. at 21 [hereinafter Figure 3].
Quantitative analysis alone would have missed these surprising results and would have underrepresented “the extent to which the introduction of ShotSpotter technology in Chicago has changed the way CPD members perceive and interact with individuals present in areas where ShotSpotter alerts are frequent.” Although the OIG reviewed only 72 of the 1,366 reports that referred to ShotSpotter but were not associated with a specific alert, it concluded that “[s]ome officers, at least some of the time, [were] relying on ShotSpotter results in the aggregate to provide an additional rationale to initiate stop or to conduct a pat down once a stop has been initiated.”

According to the company’s materials, ShotSpotter is not meant to be used this way. As one of the company’s promotional videos explains, if a gun is fired in an area where sensors are located, the information for a particular suspected gunshot is sent to the company for analysis. The identification of a probable gunshot is then routed to the police, who can be dispatched to the scene “to engage the shooter, interview witnesses, and collect key evidence at the crime scene.” In other words, ShotSpotter is intended to be used for the identification of specific gunshots to help police with more rapid and efficient responses.

C. WHY AUTOMATION SURPRISES MATTER IN POLICING

We should not dismiss this subset of stop reports as instances where a technological tool has been misused or misunderstood by the police. These unexpected uses of ShotSpotter reveal how automation can change the act of policing in unexpected ways, rather than simply providing the

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139. Id. at 21–22 [hereinafter Figure 4].
140. Id. at 19.
141. Id.
142. See ShotSpotter, supra note 60.
143. Id.
police with an additional tool. The technology has changed the way some police officers “perceive and interact with individuals present in areas where ShotSpotter alerts are frequent.” 144 The broad assumption that certain places were associated with gunshot detection alerts was “substantively changing police behavior” in Chicago. 145 These were not police responses to specific incidents of probable gunshots. Automation changed police behavior through its very existence. 146

Assuming that ShotSpotter would simply swap out human eyes and ears for machines is an example of the “substitution myth.” In reality, the introduction of automation can “transform[] practice[s].” 147 To be sure, the technology often did work as intended: alerts led to police responses in places where probable gunshots had been detected tens of thousands of times. But it also created an unintended cognitive shortcut: the mere awareness that certain neighborhoods had been associated with a high but unspecified number of alerts became an indicator of suspiciousness. No official directive told officers whether a certain number of alerts over a specific period of time in a particular place could help justify characterizing a person found there as suspicious. Yet these generalized references to the technology’s alerts became a “fact” used to help justify a stop or frisk. 148

Recall that OIG’s conclusion was based on its quantitative analysis of more than 50,000 alerts. 149 Chicago’s protocols, which send a police response to every ShotSpotter alert, “rarely produce evidence of a gun-related crime, rarely give rise to investigatory stops, and even less frequently lead to the recovery of gun crime-related evidence during an investigatory stop.” 150 In other words, the total number of ShotSpotter alerts yielded very few investigative successes for the police.

Individual officers did not, of course, make these calculations when they referred to a place as a site of multiple prior alerts. Instead, they made their own quick judgments that certain areas were subject to multiple alerts and therefore would help justify a Terry stop, frisk for weapons, or both. This was an unexpected consequence of introducing this particular form of automation into police work—one that changed police officers’ perceptions and behavior in the neighborhoods they patrolled and the people they encountered. 151

144. OIG Report, supra note 14, at 19.
145. Id. at 22.
146. See ROBINSON & BOGEN, supra note 6, at 19 ("[A]utomation and quantification change the things they touch.").
148. Id. at 2 (noting that surprises can occur when automation is based upon “designers’[’] assumptions about intended rather than actual use of automation”).
149. See text accompanying supra note 82.
150. OIG Report, supra note 14, at 22.
151. Id. at 3 (“Introduction of ShotSpotter technology in Chicago has changed the way some CPD members perceive and interact with individuals present in areas where ShotSpotter alerts are frequent.”).
Identifying such effects matters for several reasons. First, the ShotSpotter example demonstrates how human discretion can creep into automated decision-making. Inferring that a large number of alerts means a place is dangerous and people found within it could pose dangers to the police is not an intended use of the technology. Both ShotSpotter and the CPD presume police responses that are premised on specific alerts. Yet as the OIG Report uncovered, officers in Chicago used what they assumed about ShotSpotter alerts in the aggregate to justify Terry stops. Under some conditions, such assumptions might be justified. One can imagine a block or a set of blocks where multiple alerts did yield evidence of gun violence on repeated occasions. But the surprising reports identified by the Chicago OIG did not reference any particular number of alerts in any particular time frame. “Many ShotSpotter alerts” became shorthand for officers’ belief that an area was generally dangerous whether or not it actually was dangerous.

Perhaps such intuitions are no different than a sense that a neighborhood is a “high crime area.” Courts permit the police to rely on such determinations as part of the justification for a stop. After all, the Supreme Court permitted such a broad statement to be part of the reasonable suspicion calculus, and in a case arising in Chicago, no less. If the two justifications are similar, however, we can level the same critiques at them. That a place is a “high-crime area . . . is hardly ever empirically supported with factual evidentiary proof” yet is repeatedly accepted by courts as a valid factor for reasonable suspicion. And as legal scholars have pointed out, the “high-crime” designation often results in discriminatory policing in low-income communities of color.

ShotSpotter’s application in Chicago raises the concern that it is left entirely up to individual officers whether and how to use these generalized references to multiple alerts. Individual officer decisions about whether or not a neighborhood is a site of multiple aggregate alerts are only vaguely data-driven at best, and those discretionary choices can increase the potential for violence at the hands of the police. Every individual ShotSpotter alert dispatches a police response to an area where there may be an armed individual, and the perception that an area is associated with multiple alerts can influence police decision-making on the scene.

152. See supra Section III.B.2.
153. See Illinois v. Wardlow, 528 U.S. 119, 124 (2000) (“[W]e have previously noted the fact that the stop occurred in a ‘high crime area’ among the relevant contextual considerations in a Terry analysis.”) (citing Adams v. Williams, 407 U.S. 143, 144, 147–48 (1972)).
155. See, e.g., David A. Harris, Factors for Reasonable Suspicion: When Black and Poor Means Stopped and Frisked, 69 Ind. L.J. 659, 677–78 (1994) (“African Americans and Hispanic Americans make up almost all of the population in most of the neighborhoods the police regard as high crime areas.”).
about potential threats and whether to resort to force. 156

Second, the way ShotSpotter unexpectedly altered police behavior in Chicago has ramifications elsewhere. ShotSpotter itself claims that at least 120 cities around the country have contracted for its services. 157 If the behavior of Chicago police officers has been changed by the use of ShotSpotter, we should expect similar behavior in these other cities. We can also apply the insights from Chicago to other police technologies besides acoustic gunshot detection. Consider predictive policing software, which analyzes historical crime data and other factors to predict which locations are more likely to be sites of criminal offenses in the future. 158 Like ShotSpotter, predictive policing programs are designed to direct specific responses to individual forecasts about crime and place. Just as in Chicago, however, individual police officers in a department using predictive policing might rely not only on specific alerts but also on generalized assessments that certain neighborhoods, blocks, or locations are sites of previous predictions in the aggregate. A reference to “multiple predictive alerts” associated with a place may become part of the justification an officer uses for an investigative detention or frisk of a person encountered there. That same approach might also be used in future applications, like ongoing live facial recognition that looks for wanted persons. All of these represent unexpected consequences of police using technology that leads to highly discretionary decision-making.

Moreover, these discretionary uses are at odds with the rhetoric of these technologies: assertions about precision techniques that represent the cutting edge of AI in policing. 159 The Deputy Director of the CPD responded to the OIG Report’s findings by emphasizing the “real-time alerts of detected gunfire enabling patrol officers to arrive at a precise location of a shooting event quickly.” 160 Police reliance on a generalized assertion that a place has been subject to multiple ShotSpotter alerts in the past may not be so different from calling it a “high-crime neighborhood.” 161 Yet there is a difference. Police chiefs describe ShotSpotter as a


160. WGN Web Desk & Davis, supra note 57.

161. See text accompanying supra notes 153–54.
technological “game-changer,” but in reality, it can obscure the use of very human, discretionary (and flawed) decision-making.

If police are incorporating automated decision-making into their own ordinary discretionary choices, then we can apply familiar tools of analysis. “American police have always had a great deal of discretion.” Judges, legislators, and scholars have explored how to exercise that authority and what restraints should be imposed upon it for more than sixty years. Why does it matter to identify and understand automation in policing as an issue of police discretion? It matters because issues of discretion can be readily understood and addressed. They are neither novel nor require highly technical knowledge. These are ordinary and persistent problems in policing.

Third, traditional Fourth Amendment law is unlikely to say much about tools like ShotSpotter, even as it appears to change police perceptions and behavior. The required Fourth Amendment standard for stop-and-frisk searches is reasonable suspicion, which the Supreme Court has explained involves “commonsense, nontechnical conceptions that deal with the factual and practical considerations of everyday life on which reasonable and prudent men, not legal technicians, act.” Legal scholars have widely criticized the standard as so vague as to be virtually meaningless, thus permitting almost entirely discretionary stops, particularly against communities of color. Indeed, the Court’s analysis in Terry acknowledges the limited ability of courts to rein in police conduct concerning

162. AP Report, supra note 56 (“Police chiefs call ShotSpotter a game-changer.”).
163. See Brayne, supra note 28, at 982 (“[A]lthough part of the appeal of big data lies in its promise of less discretionary and more objective decision-making, . . . new analytic platforms and techniques are deployed in preexisting organizational contexts . . . .”).
165. The “discovery” of police discretion is usually attributed to the pioneering study of the American Bar Foundation in the 1950s, which turned conventional thinking about the police “on its head.” See George L. Kelling, Nat’l Inst. Just., “Broken Windows” and Police Discretion 21–23 (1999), https://www.ojp.gov/pdffiles1/nij/178259.pdf [https://perma.cc/6VE4-3XJX]. That discovery spawned a robust body of research by sociologists, criminologists, and legal academics. See, e.g., Kenneth Culp Davis, An Approach to Legal Control of the Police, 52 Tex. L. Rev. 703, 706 (1974) (“Police discretion is absolutely essential. It cannot be eliminated. Any effort to eliminate it would be ridiculous. But unnecessary police discretion can and should be eliminated, and necessary discretion can and should be controlled—can and should be properly confined, structured, and checked.”).
166. See, e.g., Joseph Goldstein, Police Discretion Not to Invoke the Criminal Process: Low-Visibility Decisions in the Administration of Justice, 69 Yale L.J. 543, 543 (1960) (observing that decisions of police discretion “not to invoke the criminal process . . . are generally of extremely low visibility” and yet their review “is essential to the functioning of the rule of law in our system of criminal justice”).
Courts have begun to decide cases involving ShotSpotter alerts, and the emerging picture suggests that even a single alert can be part of the reasonable suspicion calculus. In a 2020 decision, the Seventh Circuit concluded that ShotSpotter was “analogous to an anonymous tipster” and that two alerts, along with other factors, were sufficient to provide reasonable suspicion for a stop. In 2022, a Massachusetts appeals court held that the police’s stop and frisk search of a defendant was supported by reasonable suspicion, based in part on a ShotSpotter alert. The court noted that police reliance on ShotSpotter did not depend on the technology’s “reliability as an indicator of ‘actual’ gunshots, but merely an indicator of ‘potential’ gunshots, i.e., noises that could be gunshots.” Instead, the alerts are akin to an “acoustic trail of breadcrumbs,” permitting the inference that the individual the officer encountered might be connected to the possible gunshot detected.

Technological tools like ShotSpotter, including predictive policing forecasts, are unlikely to alter how courts view the Fourth Amendment. Andrew Ferguson posits that courts will likely consider predictive policing forecasts legitimate factors supporting investigative stops. Courts will likely view a single alert, multiple alerts, and perhaps even nonspecific references to multiple prior alerts similarly contributing to a totality of the circumstances supporting reasonable suspicion. Accepting these new types of information may tell us more about the “malleability” of reasonable suspicion than anything else.

Finally, Chicago’s experience with acoustic gunshot detection technology suggests that these tools may yield few benefits in crime prevention or investigation while also resulting in continued patterns of discriminatory policing. To summarize, the evidence from Chicago suggests that the vast majority of alerts yielded no evidence of crime—whether related to guns or otherwise—yet also sent police officers who believed they may be

169. See, e.g., Debra Livingston, Police Patrol, Judicial Integrity, and the Limits of Judicial Control, 72 St. John’s L. Rev. 1353, 1359 (1988) (“The [Terry] Court recognized that police engage in abusive conduct in street encounters for purposes wholly unrelated to any legitimate interest in investigating crime or keeping the peace . . . [and] admitted that its decision was unlikely to stop such behavior.”).


171. United States v. Rickmon, 952 F.3d 876, 882, 885 (7th Cir. 2020). The appeals court did note in dicta, “[W]e question whether a single ShotSpotter alert would amount to reasonable suspicion.” Id. at 881; see also United States v. Jones, 1 F.4th 50, 53 (D.C. Cir. 2021) (finding reasonable suspicion for Terry stop did exist based in part on ShotSpotter alert where police encountered defendant).


173. Id. at 719 n.8.

174. Id. at 717.

175. Ferguson, supra note 158 at 312 (“While never enough alone, with some relevant corroboration, a predictive tip will serve as the basis of a constitutional stop . . . . [T]he weight of predictive policing in the totality has the potential to be significant.”).

176. See id.
encountering someone armed with a gun to majority Black and Hispanic neighborhoods, sometimes dozens of times a day.\textsuperscript{177} Although police responding to a technological alert may be novel, residents in these neighborhoods may experience familiar patterns of policing—officers deployed to the same neighborhoods multiple times a day expecting volatile situations. With ShotSpotter alerts, responding officers have a “system telling [them] that anybody in the area is a mortal threat.”\textsuperscript{178} These deployments can lead to more stops, frisks, tense encounters, and the potential for mistaken perceptions on the part of police or civilians that can lead to unnecessary violence. Relying on generalized and nonspecific views on previous alerts provides police with more latitude to justify these decisions. This increase in the amount and degree of tension and potentially deadly interactions with the police can exacerbate community alienation from the police.\textsuperscript{179}

What results are increased possibilities for stop-and-frisks for those who are already subject to intensive policing practices in the city of Chicago. A 2015 study reported that, during 2014, residents of Chicago were subjected to police stops “more than four times as often as New Yorkers at the height” of that city’s controversial stop and frisk policies from 2002 to 2013.\textsuperscript{180} A review of police stops in Chicago conducted over a four-month period revealed that 72\% of those stopped were Black residents, who account for just 32\% of the city’s population.\textsuperscript{181} When viewed against the findings of both the Chicago OIG and the MacArthur Justice Center, these statistics reveal increased risks without clear public benefits.

In Chicago, these risks have a special significance. The Justice Department’s 2015 investigation of the CPD found that the city’s predominantly Black and Hispanic neighborhoods “experience policing in a fundamentally different way than do [W]hite individuals and [W]hite commu-

\textsuperscript{177} Cf. MacArthur Report, supra note 87, at 2 (“On an average day in Chicago, the ShotSpotter system sends police out on more than sixty dead-end searches for gunfire.”).

\textsuperscript{178} Feathers, supra note 88.

\textsuperscript{179} See Monica C. Bell, Police Reform and the Dismantling of Legal Estrangement, 126 YALE L.J. 2054, 2107–08 (2017) (“Legal estrangement, emerging out of personal and vicarious experiences, serves as a lens through which many African Americans interpret past and future engagements with law enforcement officials.”).


\textsuperscript{181} STOP AND FRISK IN CHICAGO, supra note 180, at 8.
ties. Residents of majority Black and Hispanic neighborhoods felt that their communities were simultaneously over-policed and under-policed. Tactics like “jump-outs,” in which police randomly paused their patrol cars and opened their doors to see if residents would run, and repeated stops, interviews, and searches of young people made some communities’ members feel like they lived in “an open-air prison” guarded by “an occupying force.” At the same time, victims of crime in these same neighborhoods expressed views that the police were unsympathetic to their concerns and took few concrete steps to solve homicides.

In 2019, a federal judge approved a consent decree for policing reforms after the state’s attorney general sued for reforms based on the Justice Department’s report. In 2021, the independent monitor of the consent decree found that the Chicago Police had failed to comply with 120 of 315 requirements and had failed to meet 26 out of 43 agreed-upon deadlines.

IV. CONCLUSION

The increasing role of AI in policing has an understandable appeal to the police; it promises high-tech solutions to address criminal investigations faster and more efficiently. Yet this new technology may fail to deliver on these promises and introduce new, unanticipated complications. Automation in policing will not merely serve as a substitute for human tasks or perform those tasks more quickly. It can also change policing behaviors. Evidence from the use of acoustic gunshot detection technology in Chicago provides one such extended example. The major finding of the OIG was significant: the ShotSpotter technology rarely led officers to the evidence of gun violence it was designed to detect. Instead, some police began to rely on more generalized references to past alerts. The CPD case study highlights a longstanding problem of police discretion that the application of new technology should not obscure, and it also

183. Id. at 143.
184. Id. at 140, 142.
raises new questions about the unanticipated ramifications of new police technologies across the law enforcement spectrum.