In the Supreme Court of Pennsylvania

No. 12 WAP 2024

COMMONWEALTH OF PENNSYLVANIA,
Appellee

v.

JAMAR FOSTER,
Appellant

AMICI CURIAE BRIEF OF THE PENNSYLVANIA INNOCENCE PROJECT THE INNOCENCE PROJECT, AND THE PENNSYLVANIA ASSOCIATION OF CRIMINAL DEFENSE LAWYERS IN SUPPORT OF APPELLANT JAMAR FOSTER

By Allowance of Appeal from the Judgment of the Superior Court of Pennsylvania entered July 17, 2023, at No. 619 WDA 2022, Affirming the Judgment of Sentence of the Court of Common Pleas of Allegheny County entered July 17, 2022, at No. CC 13992-2019

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IDENTITY AND INTEREST OF AMICI CURIAE

The **Pennsylvania Innocence Project** ("PAIP") is a nonprofit legal clinic and resource center with offices at Temple University's Beasley School of Law and the Thomas R. Kline Law School of Duquesne University School of Law. Its board of directors and advisory committee include practicing lawyers, law professors, former state and federal prosecutors, former judges, and wrongly-convicted individuals who have been exonerated. Collaborating with *pro bono* private counsel, PAIP provides investigative and legal services to indigent prisoners throughout Pennsylvania. These individuals have claims of actual innocence supported by DNA testing or other powerful exculpatory evidence or have claims that, after a preliminary investigation, evince a substantial potential for discovery of such evidence. Additionally, PAIP works to remedy the underlying causes of wrongful convictions to ensure that no one will be convicted and imprisoned for a crime they did not commit. PAIP seeks to prevent punishment of innocent people, and to prevent wrongdoers from escaping justice because an innocent person was convicted instead.

The **Innocence Project** ("IP") is a national nonprofit organization that works to free the innocent, prevent wrongful convictions, and create fair, compassionate, and equitable systems of justice. The IP's work is grounded in anti-racism and guided by science. In addition to representing individuals on post-

conviction innocence claims, the IP conducts strategic litigation and policy advocacy to effect reforms that will prevent wrongful convictions and promote the equitable administration of justice. This includes advocating to ensure that forensic and investigative tools (1) do not create an improper risk of sweeping innocent people into the criminal legal system and (2) undergo sufficient empirical validation to establish their reliability before they are used in investigation or prosecution. Given the stark racial disparities documented in known wrongful convictions and the contributions of faulty forensic evidence to many of those convictions, the IP also seeks to ensure that forensic and investigative tools do not exacerbate or mask racial disparities in policing and prosecutions.

The **Pennsylvania Association of Criminal Defense Lawyers** ("PACDL") is a professional association of attorneys admitted to practice before the Supreme Court of Pennsylvania who provide criminal defense representation. As Amicus Curiae, PACDL presents the perspective of experienced criminal defense attorneys who aim to protect and ensure by rule of law those individual rights guaranteed by the Pennsylvania and United States Constitutions. PACDL's membership includes more than 900 private criminal defense practitioners and public defenders throughout the Commonwealth. PACDL works to achieve justice and dignity for defense lawyers, defendants, and the criminal justice system itself. PACDL members represent criminal defendants detained or arrested based on technological

or algorithmic evidence, and, in that capacity, must ensure that such evidence bears sufficient indicia of reliability to support the police action at issue. PACDL addresses the Court in this matter due to the proliferation of technological surveillance tools in Pennsylvania and the continued need to vigorously protect the right against unreasonable search and seizure.

Pursuant to Rule 531(b)(2), amici certify that no person or entity was paid in whole or in part to prepare this brief. Only *pro bono* counsel authored this brief.

INTRODUCTION

Unvetted and unvalidated forensic tools produce wrongful convictions. Even when used as "investigative leads" rather than trial evidence, they can expose innocent people to unconstitutional arrests, unsupported charges, and, ultimately, unjust incarceration. Flawed forensics are a leading cause of wrongful convictions, implicated in over a quarter of all known exonerations and over half of the Innocence Project's DNA exonerations. Nat'l Registry of Exonerations, *% Exonerations by Contributing Factor* (2024), *available at* https://www.law.umich.edu/special/exoneration/Pages/ExonerationsContribFactorsByCrime.aspx (last accessed July 2, 2024)[1]; Innocence Project, *Explore the Numbers: Innocence Project's Impact* (2024), *available at* https://innocenceproject.org/exonerations-data/ (last accessed July 3, 2024).[2] Overreliance on such tools erodes the presumption of innocence by circumventing the requirement that police have an objective, reliable basis to suspect a specific person of a crime before they can detain that person. And disproportionate use of such tools in communities of color risks worsening the racial disparities already present in wrongful convictions and the criminal legal system writ large.

[1] Permanent link at https://perma.cc/ZJ38-EBAA.
[2] Permanent link at https://perma.cc/69ET-9AQ9.

ShotSpotter is such a tool. When police rely on third-party information to conduct an investigative stop, the Commonwealth must show that information to be reliable. This requirement applies no matter whether the source is a human informant or, as here, a technological system. What differs are the methods of evaluating the source's reliability. With tools like ShotSpotter, the key to establishing reliability is independent, empirical verification and validation—which ShotSpotter has not undergone.

Though it purports to detect and locate gunfire, ShotSpotter remains unvalidated, rarely yields actionable evidence, and has already precipitated multiple alleged wrongful arrests. In fact, ShotSpotter alerts rarely lead to evidence of firearms at all. *See, e.g.*, Joseph M. Ferguson & Deborah Witzburg, Chi. Off. of Inspector Gen., *The Chicago Police Department's Use of ShotSpotter Technology* 3, 14 (2021), *available at* https://igchicago.org/wp-content/uploads/2021/08/Chicago-Police-Departments-Use-of-ShotSpotter-Technology.pdf (last accessed July 1, 2024) (finding just 9.1% of ShotSpotter alerts result in gun-crime-related dispositions); N.Y.C. Off. of the Comptroller, *Audit Report on the New York City Police Department's Oversight of Its Agreement with ShotSpotter Inc. for the Gunshot Detection and Location System*, FP23-074A 9-12 11 (June 20, 2024), *available at* https://comptroller.nyc.gov/wp-content/uploads/documents/FP23-074A.pdf (last accessed July 1, 2024)

(hereinafter "NYC Comptroller Report") (finding ShotSpotter alerts from January to June 2023 yielded evidence of an actual shooting just 8% to 13% of the time).

On its own, ShotSpotter provides neither reliable evidence of criminal activity nor particularized evidence pointing to any specific individual. It merely detects "impulsive sounds"; it cannot establish what produced those sounds, let alone provide a description of anyone involved. Its opaque "black-box" algorithms were built to designate sounds as gunfire or non-gunfire using unverified and potentially mislabeled sound files—so the algorithm might be using non-gunfire sound files to learn how to "identify" gunfire. And its developer has not yet subjected those algorithms to well-established validation procedures that would test their reliability in conditions that match those where they are deployed. Permitting investigative detentions based on nothing but uncorroborated ShotSpotter alerts would make targets of innocent people, creating a pretext to detain everyone in the vicinity of an alert—even if the alert were, as they often are, erroneously issued for something other than gunfire. This defies both the Fourth Amendment and Article I, Section 8 of the Pennsylvania Constitution.

Moreover, ShotSpotter's disproportionate deployment in communities of color threatens to exacerbate racial disparities in policing, criminal legal system exposure, and ultimately wrongful convictions. ShotSpotter, by definition, sends police only to neighborhoods where it has microphones installed—largely

neighborhoods where most residents are Black and brown, as recent reporting shows. If police may stop anyone in the area based simply on the fact that they happen to live, work, or commute near a ShotSpotter alert, the result will be a two-tiered system of constitutional protection: Residents of neighborhoods with ShotSpotter—mostly people of color—will face a reduced presumption of innocence and reduced protection against government intrusion compared to residents of neighborhoods without it.

Considering all this, ShotSpotter on its own cannot supply reasonable suspicion. Where, as here, police respond to one or more ShotSpotter alerts and find no further evidence of gunfire at the scene, the ShotSpotter alerts should not give them license to stop anyone in the area.

THE SHOTSPOTTER SYSTEM

The ShotSpotter system, operated by the company SoundThinking, Inc., purports to detect, identify, and locate possible gunshots. *See* SoundThinking, Inc., *ShotSpotter Frequently Asked Questions* (2023), *available at* https://www.soundthinking.com/faqs/shotspotter-faqs/ (hereinafter "*ShotSpotter FAQs*") (last accessed July 1, 2024).[3] It uses microphones, computer algorithms, and human reviewers to alert police agencies of sounds it designates as potential gunshots. *Id.* First, microphone sensors, placed around a neighborhood and

[3] Permanent link at https://perma.cc/G62T-XUS7.

calibrated according to parameters SoundThinking sets, activate upon detecting "impulsive sounds" that fit those parameters. *Id.* Second, when multiple sensors activate, a computer algorithm estimates the sound source's location based on the time each sensor detected the noise and the site of the sensors. *Id.* Third, a different algorithm classifies the noise as either a "potential gunshot" or non-gunfire. *Id.* Finally, a human employee reviews sounds classified as potential gunshots and makes the final decision whether to alert police. *Id.*

All of these steps involve uncertainty and potential error. Several aspects of the system's design suggest that ShotSpotter's rate of false positive errors—where it mistakenly issues an alert for non-gunfire—can be high. Despite this, the trial court and Superior Court here both incorrectly assumed that ShotSpotter provided conclusive evidence of gunfire. Opinion at 1–2, *Commonwealth v. Foster*, No. CC 13992-2019 (Ct. Common Pleas Allegheny Cty. July 17, 2022); *Commonwealth v. Foster*, 303 A.3d 757 (Table), No. 619 WDA 2022, 2023 WL 4557061, at *1, *6 (Pa. Super. Ct. July 17, 2023) (agreeing with Commonwealth's assertion that "ShotSpotter detected … a total of five shots" without considering that detected noises could have been something other than gunfire). An overview of ShotSpotter's process, along with the uncertainties and possible errors it involves, demonstrates why this assumption is flawed.

A. ShotSpotter Microphones Activate for Many "Impulsive Sounds," Not Just Gunshots.

ShotSpotter microphones do not respond only to gunfire. Rather, they are overinclusive of noises that sound *like* gunshots, including many non-gunfire sounds. Functioning sensors activate whenever they detect an "impulsive sound"—a loud, sudden noise with sharp onset and rapid dissipation. SoundThinking, Inc., *ShotSpotter FAQs*, *supra*; *see* Izabela L. Freire & José A. Apolinário Jr., *Gunshot detection in noisy environments*, 7th Int'l Telecomm. Symposium 1 (2010). Common impulsive sounds include firecrackers, cars backfiring, balloons popping, construction noise, and helicopters. Brendan Max, *SoundThinking's Black-Box Gunshot Detection Method: Untested and Unvetted Tech Flourishes in the Criminal Justice System*, 26 Stan. Tech. L. Rev. 193, 206–07 (2023); Freire & Apolinário, *supra*, at 1.

To try to avoid missing actual gunfire, the sensors are overbroad by design—that is, they deliberately screen in many non-gunfire sounds. SoundThinking itself, in a non-peer-reviewed paper authored by its employees, admits that ShotSpotter's "acceptance criteria for muzzle blast impulses must necessarily be broad" because sounds undergo "significant attenuation" before reaching the sensors, making it harder to discern impulsive noises from background noise. Robert B. Calhoun et al., *Precision and accuracy of acoustic gunshot location in an urban environment* 2

(2021), *available at* https://arxiv.org/pdf/2108.07377 (last accessed July 1, 2024). False positives are thus literally built into the system.

B. ShotSpotter's Machine Learning Model for Classifying Sounds Is Built from Flawed Data Consisting of Mostly Unknown and Potentially Mislabeled Sounds.

The risk of false positive errors extends to the sound classification algorithm, which is built on flawed data and likely misidentifies non-gunfire as gunfire far more than SoundThinking claims. To put it simply: the algorithm learns what is gunfire from sound files that may or may not actually be gunfire and, conversely, what is not gunfire from sounds that may, in fact, be gunfire. No consensus exists on how to distinguish gunfire from similar but innocuous sounds, or whether it is even possible to do so reliably. *See* Juan R. Aguilar, *Gunshot Detection Systems in Civilian Law Enforcement*, 63 J. Audio Eng'g Soc'y 280, 284–85 (2015). "Detecting a gunshot is perhaps the most demanding task in acoustical signature analysis," especially in urban environments where background noise, other impulsive sounds, and reverberation often interfere. *Id.* at 284. It is impossible to determine whether any given approach to this task is reliable without appropriate empirical testing, which ShotSpotter has not undergone.

ShotSpotter's automated sound classification method is an opaque, black-box machine learning model. Calhoun et al., *supra*, at 8–9; *see also* Jeremy Petch et al., *Opening the Black Box: The Promise and Limitations of Explainable*

Machine Learning in Cardiology, 38 Canadian J. Cardiology 204, 204 (2022) (defining black-box models as "sufficiently complex that they are not straightforwardly interpretable to humans"). Rather than pre-coding each step of the sound classification process, SoundThinking "trains" the model on a large set of prelabeled sound recordings, in theory allowing the model to extrapolate acoustic features that characterize gunfire. Calhoun et al., *supra*, at 8.

The problem is that inaccurate training data produces inaccurate models—and the dataset of sounds used to train ShotSpotter's model may largely be mislabeled. "To properly train a predictive model, historical data . . . must be correct [and] properly labeled." Thomas C. Redman, *If Your Data Is Bad, Your Machine Learning Tools Are Useless*, Harv. Bus. Rev. (Apr. 2, 2018), *available at* https://hbr.org/2018/04/if-your-data-is-bad-your-machine-learning-tools-are-useless (last accessed July 1, 2024).[4] It must also represent the full range of inputs the model will encounter when deployed. *Id.* But for "the vast majority" of the field-collected recordings used to train ShotSpotter's model, ground truth—the actual source of the sounds—is unknown, and "it is to be expected that some training data are misidentified." Calhoun et al., *supra*, at 8. Much of the training data, therefore, could well be non-gunfire mislabeled as gunfire; if so, the model built from that data would be likely to repeat those errors.

[4] Permanent link at https://perma.cc/Q5TA-NA7W.

C. SoundThinking Has Not Established That ShotSpotter Can Accurately Estimate the Location of a Sound Source in Dense Urban Environments.

ShotSpotter struggles to not only identify gunfire, but also accurately locate the source of an impulsive sound. That is because environmental factors can impair its location calculation. It estimates a noise's location using the speed of sound and the difference in the noise's arrival time to each activated sensor. *See* SoundThinking, Inc., *ShotSpotter FAQs*, *supra*, *ShotSpotter FAQ*; Calhoun et al., *supra*, at 4-5. This may seem straightforward in theory. However, acoustic engineering research (including by SoundThinking's own employees) shows that in urban environments, this task involves substantial risk of error because wind, background noise, temperature, and physical obstructions can all delay or distort sounds before they reach a sensor. Calhoun et al., *supra*, at 2–3, 6–7; Aguilar, *supra*, at 286–87.

These factors introduce several uncertainties. First, they make it harder to select which sensors to use for a location estimate. Calhoun et al., *supra*, at 3–4. While sensors with a line-of-sight path to the sound source are preferred, they cannot always be identified because the acoustic data they receive does not indicate whether the sound traveled directly or indirectly, with diffractions, refractions, or echoes. *See id.;* Aguilar, *supra*, at 286–87. Similarly, because unobstructed paths are rare in heavily built environments, a given sound pulse at a

sensor may reflect an echo rather than the original sound signal. Calhoun et al., *supra*, at 2. When the same sound takes multiple paths to reach a sensor, "a simple source signal" becomes "a complicated received signal," making it hard to distinguish a series of impulsive noises from a single noise and its echoes. *Id.* Such distortions can also bias timing and distance estimates. Aguilar, *supra*, at 287.

Each of these uncertainties can introduce substantial error. *See id.* (noting "high sensitivity of gunshot detection algorithms to [non-line-of-sight] conditions, acoustic multipaths, background noise, and wind"). One study found that when sensors were not within line of sight to a sound source, they failed to correctly gauged the direction from which a sound came as much as 60% of the time. P. Naz et al., *Acoustic Detection and Localization of Small Arms, Influence of Urban Conditions*, Proc. SPIE 6963: Unattended Ground, Sea, & Air Sensor Tech. & Applications 69630E at 3 (2008). Another found that fast wind speeds could double the magnitude of the location error. *See* Aguilar, *supra*, at 287 (citing Kam Lo & Brian Ferguson, *Localization of small arms fire using acoustic measurements of muzzle blast and/or ballistic shock wave arrivals*, 132 J. Acoustic Soc. Am. 2997 (2012)).

D. SoundThinking Has Provided No Evidence that Its Human Reviewers Can Accurately Distinguish Gunfire from Non-Gunfire.

ShotSpotter's use of human reviewers does not obviate the risk of false positives. Humans may misidentify non-gunfire as gunfire as or more often than ShotSpotter's algorithm; there is no empirical evidence to demonstrate that the human ear can reliably distinguish gunshots from other impulsive sounds. To assess whether a ShotSpotter employee could do so at rates better than chance, that employee would have to be tested on a range of sound files where ground truth is known. SoundThinking has not publicly reported any such testing. While it bills its employees as "acoustic experts," *see* SoundThinking, *ShotSpotter FAQs*, *supra*, it has resisted providing information about any training or proficiency testing those employees undergo, *see People v. Jones*, 220 N.E.3d 475, 490 (Ill. App. 3d Div. 2023) (noting company's objections to providing even anonymized employee training and proficiency records). Without testing against known-ground-truth samples, its employees' true error rates cannot be known.

ARGUMENT

A. Without Corroboration, ShotSpotter Is Too Unreliable to Provide Reasonable Suspicion and Exposes Innocent People to Unjustified Stops.

1. The Commonwealth must demonstrate ShotSpotter's reliability before relying on it for reasonable suspicion.

Both the United States and Pennsylvania Constitutions are clear: Evidence obtained via an unreasonable search or seizure must be suppressed. U.S. Const.

amend. IV; Pa. Const. art. I, § 8; *Mapp v. Ohio*, 367 U.S. 643, 655 (1961); *Commonwealth v. Arter*, 151 A.3d 149, 153–54 (Pa. 2016).

The Commonwealth bears the burden at a suppression hearing to establish, by a preponderance of the evidence, that it obtained the challenged evidence lawfully. *Commonwealth v. Davis*, 421 A.2d 179, 181 (Pa. 1980). Evidence obtained via an investigative detention is admissible only if the detaining officer had reasonable suspicion, supported by "specific and articulable facts," that the detained individual was engaged in criminal activity. *Terry v. Ohio*, 392 U.S. 1, 21 (1968); *see also Commonwealth v. Brown*, 996 A.2d 473, 476–77 (Pa. 2010) (noting commensurate protections from federal and state constitutions for investigative detentions). This is an objective standard; what matters is not the officer's subjective belief, but whether the officer had an objectively reasonable basis to think that criminal activity was afoot and that the defendant was involved. *Commonwealth v. Holmes*, 14 A.3d 89, 96 (Pa. 2011); *cf. Jones*, 220 N.E.3d at 489 (explaining that for a stop based on ShotSpotter, prosecution must "show that the information that ShotSpotter sent to police . . . was reliable, regardless of what the officers . . . knew or did not know about ShotSpotter's system").

When police detain someone based on information beyond officers' own observations, the Commonwealth must also show that this information is reliable. Reasonable suspicion "depends on the information possessed by police *and its*

degree of reliability in the totality of the circumstances." *Brown*, 996 A.2d at 477 (emphasis added). This analysis considers "both the content of the information possessed by the police and its degree of reliability." *Commonwealth v. Goodwin*, 750 A.2d 795, 798 (Pa. 2000). When "information has a low degree of reliability, then more information is required to establish reasonable suspicion." *Id.*

2. For ShotSpotter, the reliability required for reasonable suspicion can be established only through appropriate empirical validation.

Far from being objective, algorithm-based systems like ShotSpotter can and do make mistakes. Mistakes may arise from coding errors, skewed training or input data, mismatches between the systems' conditions of development and conditions of deployment, and misinterpretation of the algorithms' results by humans. *See, e.g.*, Andrea Roth, *Machine Testimony*, 126 Yale L. J. 1973, 1977–78 (2015) (noting risk of "human error at the programming, input, or operation stage" and "machine error due to degradation and environmental forces").

In the law enforcement arena, algorithmic systems are proliferating—and have already produced deadly miscarriages of justice and troubling racial disparities. *See, e.g.*, Michael Brenner et al., *Constitutional Dimensions of Predictive Algorithms in Criminal Justice*, 55 Harv. C.R.-C.L. L. Rev. 267, 268 (2020) ("Artificial intelligence and algorithmic tools are rapidly becoming embedded in our criminal justice system."). For instance, a predictive police

algorithm in Chicago identified Robert McDaniel as likely to be involved in a gun incident despite his lack of violent history, prompting officers to target him for extended surveillance; that surveillance then led to him getting shot as a suspected police informant. Matt Stroud, *Heat Listed*, The Verge (May 24, 2021), *available at* https://www.theverge.com/c/22444020/chicago-pd-predictive-policing-heat-list (last accessed July 2, 2024). Similarly, faulty facial recognition software "matches" have prompted several wrongful arrests—all but one of Black people. *See* Khari Johnson, *How Wrongful Arrests Based on AI Derailed 3 Men's Lives*, Wired (Mar. 7, 2022), *available at* https://www.wired.com/story/wrongful-arrests-ai-derailed-3-mens-lives/ (last accessed July 2, 2024); Kashmir Hill, *Eight Months Pregnant and Arrested After False Facial Recognition Match*, N.Y. Times (Aug. 6, 2023), *available at* https://www.nytimes.com/2023/08/06/business/facial-recognition-false-arrest.html (last accessed July 2, 2024).

Given the risks of error and bias, researchers, developers, and policymakers have developed frameworks for verification and validation of forensic tools, including those based on black-box algorithms. These frameworks agree on several key principles.

First, validation testing must test how often a tool or technique reaches the correct result, meaning they must measure accuracy against verifiable ground truth. *See* President's Council of Advisors on Sci. & Tech., *Forensic Science in the*

Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods 5 (2016) (hereinafter "*PCAST Report*") ("Foundational validity requires that a method has been subjected to *empirical* testing . . . [that] provide[s] valid estimates of . . . how often the method reaches an incorrect conclusion.").

Second, empirical testing must properly represent the conditions under which the tool will be deployed. Nat'l Inst. of Standards & Tech., *Artificial Intelligence Risk Management Framework* 14 (2023) ("Accuracy measurements should always be paired with clearly defined and realistic test sets—that are representative of the conditions of expected use"); *PCAST Report*, *supra*, at 47 ("For a metrological method to scientifically valid and reliable, the procedures that comprise it must be shown, based on empirical studies, to be *repeatable*, *reproducible*, and *accurate*, at levels that have been measured and are appropriate to the intended application.").

And third, this testing must be transparent and independent, conducted by parties with no professional, personal, or financial stake in the results. Inst. of Electrical & Electronics Eng'rs, *IEEE Standard for System, Software, and Hardware Verification and Validation* (Standard 1012-2016) (Sept. 2017) (stating that verification and validation processes must "use personnel who are not involved in the development of the system or its elements," meaning people other than the developers, vendors, and customers); *PCAST Report*, *supra*, at 14 ("To

ensure . . . scientific judgments are unbiased and independent, such evaluations should be conducted by an agency which has no stake in the outcome.").

3. ShotSpotter has not undergone the robust empirical testing needed to establish reliability for reasonable suspicion purposes.

The existing studies on ShotSpotter that SoundThinking publicizes fail to satisfy these well-accepted verification and validation principles. Researchers in acoustic engineering have called ShotSpotter's reliability into question based on methodological flaws in the studies its parent company touts, such as altering test protocols mid-study to inflate measures of accuracy. John Hansen & Hynek Bořil, *Gunshot Detection Systems: Methods, Challenges, and Can they be Trusted?*, 151st Audio Eng'g Soc'y Convention 7 (2021) (examining L. G. Mazerolle et al., *Field Evaluation of the ShotSpotter Gunshot Location System: Final Report on the Redwood City Field Trial*, Technical report, Doc. 180112, U.S. Dep't of Justice Award 96-MU-MU-0018-2000 (2000)).

Crucially, existing studies simply fail to measure the true false positive rate. For instance, SoundThinking's website cites a report by Edgeworth Analytics. SoundThinking, Inc., *ShotSpotter Questions, Myths and Facts* (May 16, 2024), *available at* https://www.soundthinking.com/blog/shotspotter-questions-myths-and-facts/ (last accessed July 2, 2024)[5] (citing Edgeworth Analytics, Independent

[5] Permanent link at https://perma.cc/F8C3-GMLP.

Audit of the ShotSpotter Accuracy (Mar. 28, 2022), *available at* https://www.edgeworth economics.com/assets/htmldocuments/Shotspotter-2022-Accuracy-Study.pdf (last accessed July 2, 2024) (hereinafter "Edgeworth Report")[6]). But the Edgeworth Report was hardly "independent"; it was commissioned by ShotSpotter. *Edgeworth Report*, *supra*, at 2. And though it claimed an "accuracy rate" of over 97%, it did not involve live-fire testing, did not test sounds other than gunfire (such as fireworks or construction equipment), and did not verify ground truth for most of the dispatches it considered. *Id.* It claimed to measure false positive errors but relied on law enforcement customers to report them, making no inquiry into agencies' reporting procedures or officers' compliance rates with them. *Id.* Nor did it account for the possibility that false positives likely went undiscovered and unreported when officers could not verify ground truth. *Id.*

In failing to submit to adequate validation testing, ShotSpotter mirrors other unvalidated forensic techniques known to produce wrongful convictions. The 2016 PCAST Report, for instance, examined several forensic feature-comparison disciplines and found that several of the methods examined lacked foundational validity, exhibited false positive rates far higher than laypeople would expect, or rested on methodologically deficient research. *PCAST Report*, *supra*, at 87, 101,

[6] Permanent link at https://perma.cc/2PC2-JCPM.

112. Disturbingly, many of these methods have been implicated in multiple wrongful convictions. Nat'l Registry of Exonerations, *% Exonerations by Contributing Factor*, *supra*. ShotSpotter suffers from similar shortcomings. Allowing it to support detentions without corroborative evidence of gunfire risks producing the next wave of wrongful convictions.

4. ShotSpotter alerts yield evidence of gun crimes too rarely to be considered reliable without corroboration of gun activity.

Absent robust empirical testing, ShotSpotter deployment data at least indicates how frequently it yields actionable evidence; the answer, it turns out, is very rarely. While deployment outcomes cannot precisely measure false positives, a high rate of "dead-end" alerts—alerts that fail to lead to evidence of gun crimes—suggests that the false positive rate is higher than SoundThinking claims. Moreover, in a reasonable suspicion analysis, the key question for any third-party information source is whether it consistently provides verifiable evidence crimes. *See, e.g.*, *Floyd v. City of New York*, 959 F. Supp. 2d 540, 575–76 (S.D.N.Y. 2013) (noting that low "hit rate" for stops and frisks of Black people cast doubt on whether such stops were supported by reasonable suspicion).

ShotSpotter does not. Instead, it mostly sends police to scenes where they find nothing of import. In 2016, *Forbes Magazine* obtained a database of ShotSpotter responses totaling over 25,000 individual alerts from seven cities. Matt Drange, *ShotSpotter Alerts Police to Lots of Gunfire but Produces Few Tangible*

Results, Forbes Magazine (Nov. 17, 2016), *available at* https://www.forbes.com/sites/mattdrange/2016/11/17/shotspotter-alerts-police-to-lots-of-gunfire-but-produces-few-tangible-results/?sh=719fe4fb229e (last accessed July 2, 2024).[7] It determined that, for the vast majority of ShotSpotter alerts, police found no evidence of a gun crime at the location identified—no victim, no witnesses, no bullet holes, no casings, no blood, nor any other indicator of actual gunfire. *Id.*

Other cities have replicated these findings. A 2021 investigation in Minneapolis found that roughly 80% of ShotSpotter deployments yielded no evidence of gun-related crimes. Nathan O'Neal, *ShotSpotter gunshot detection system rarely leads to arrests in Minneapolis*, Fox9 KMSP (Nov. 17, 2021), *available at* https://www.fox9.com/news/gunshot-detection-system-rarely-leads-to-arrests-in-minneapolis (last accessed July 2, 2024).[8] In Dayton, Ohio, just 5% of ShotSpotter deployments yielded evidence of *any* crime, not just gun crimes. Mawa Iqbal, *ShotSpotter Generates Thousands of Alerts in Dayton, But Officers Find Few Crimes*, WYSO (Oct. 4, 2021), *available at* https://www.wyso.org/local-and-statewide-news/2021-10-04/shotspotter-generates-thousands-of-alerts-in-dayton-but-officers-find-few-crimes (last accessed July 2, 2024).[9] And Durham,

[7] Permanent link at https://perma.cc/2EKH-JJCG.
[8] Permanent link at https://perma.cc/Q9ZN-JXLK.
[9] Permanent link at https://perma.cc/6KK9-G8FU.

North Carolina recently ended its ShotSpotter contract, finding after a one-year pilot program that more than 1,400 alerts had led to just 23 arrests. Kathryn Hubbard & Hannah Leyva, *City of Durham ends ShotSpotter contract* (Dec 19, 2023), *available at* https://www.cbs17.com/news/local-news/durham-county-news/city-of-durham-ends-shotspotter-contract/ (last accessed July 2, 2024).

Most recently, an audit in New York City reported damning results: Most deployments were dead ends, yielding no actionable evidence and wasting officers' time. NYC Comptroller Report, *supra*, at 9–12. The audit criticized the NYPD and SoundThinking for crafting a performance metric that produced "artificially high ratings" for the system. *Id.* at 7, 9. Under this metric—which only counted errors where ShotSpotter failed to detect a noise later confirmed as gunfire or detected it but incorrectly classified it as non-gunfire—ShotSpotter appeared to meet its performance standards. *Id.* But as the Comptroller pointed out, this standard "does not consider false positives or otherwise directly assess the tool's ability to identify confirmed shooting incidents." *Id.* at 9.

With false positives and actual evidence retrieval rates, ShotSpotter did much worse. Reviewing several months of deployment data, the audit found that few alerts corresponded to "confirmed shootings," or incidents where police recover "evidence such as firearms, ballistics, or video, or [where] there are eyewitnesses, victims shot, summary arrests, or 911 calls that report a shooting."

Id. Instead, police recovered firearm-related evidence from *as few as 8%* of ShotSpotter deployments in some months; none of the months sampled had an evidence recovery rate over 20%. *Id.* at 9–10. Moreover, time spent responding to unfounded and unconfirmed alerts "represent[ed] significant waste of officer hours" at great fiscal cost to the city. *Id.* at 12.

These studies show that ShotSpotter does not reliably lead to evidence of gun crime—or indeed any crime. Without corroborating evidence of gunfire, such as a 911 call, casings, bullet damage, or an eyewitness, ShotSpotter alerts on their own usually turn up nothing. They could as easily reflect innocuous, non-criminal activity, like construction or vehicle noise, as a gunshot. And they cannot connect specific individuals to a detected noise. As such, they cannot establish reasonable suspicion for a stop.

B. ShotSpotter's Disproportionate Deployment in Communities of Color Risks Exacerbating Longstanding Patterns of Racial Profiling and Discriminatory Policing.

Given its unreliability, ShotSpotter's patterns of deployment pose another serious problem: They disproportionately target communities of color, thus likely exacerbating existing racial disparities in policing, prosecution, and incarceration. Because ShotSpotter does not reliably reflect criminal activity, it instead creates a *pretext* for police to stop residents of the neighborhoods where it is deployed—an intrusion not faced by residents of neighborhoods without ShotSpotter. In doing so,

it stands to perpetuate and perhaps even worsen the already stark racial disparities in policing, and ultimately in wrongful convictions.

1. The United States, and Pittsburgh in particular, exhibit persistent racial disparities and discriminatory policing.

Despite outcry in recent years over several highly publicized killings of Black people by police, discriminatory policing remains a persistent problem in the United States. *See, e.g.*, Emma Pierson et al., *A large-scale analysis of racial disparities in police stops across the United States*, 4 Nature: Human Behavior 736, 738–39 (2020) (finding Black and Hispanic drivers were disproportionately stopped, ticketed, searched, and arrested during traffic stops, but that low rates of contraband retrieval from searches of Black and Hispanic suggested many of these stops were pretextual).

Several recent investigations by the Department of Justice (DOJ) have documented deeply entrenched patterns of racial bias. In Minneapolis, the DOJ found that police "patrol[led] differently based on the racial composition of the neighborhood, without a legitimate, related safety rationale"; discriminated when deciding whom to search; disproportionately used force against Black and Native people; and ignored long-known problems of racial bias. U.S. Dep't of Justice Civil Rights Div., *Investigation of the City of Minneapolis and the Minneapolis Police Department* 31–40 (2023). Similarly, the DOJ found in Baltimore that police there "intrude . . . disproportionately upon the lives of African Americans at

every stage of its enforcement activities." U.S. Dep't of Justice Civil Rights Div., *Investigation of the Baltimore City Police Department* 47 (2016). And in Ferguson, Missouri, the DOJ found that police practices disproportionately harmed African American residents and were motivated at least in part by racial bias, as evidenced by several instances of racial stereotyping and willful failure to address discrimination. U.S. Dep't of Justice Civil Rights Div., *Investigation of the Ferguson Police Department* 62–78 (2015).

Pittsburgh is not immune to these problems. A recent study by RAND and RTI International documented striking disparities in policing patterns, arrest likelihood, and charging rates. Shamena Anwar et al., Rand Corporation & RTI International, *Creating a Path Forward to Reduce Racial Disparities in the Criminal Justice System in Allegheny County* 31, 36, 39–46 (2023), *available at* https://iop.pitt.edu/sites/default/files/Documents/RAND_RTI_Final_Report.pdf (last accessed July 1, 2024). The study found that Black people in Pittsburgh are 4.5 times as likely as white people to be charged with an offense. *Id.* at 31.

Crucially, most of the difference in charging rates was not explained by variables typically linked to criminal activity, suggesting that they instead arose from disparate policing practices. *Id.* at 39–40. Specifically, 91.2% of the racial differences in charging rates resulted from residential segregation: Charging rates differed largely by neighborhood, with majority-Black neighborhoods having

higher rates. *Id.* at 36. But when the researchers matched neighborhoods by variables that proxy for criminal activity—age, income, years of education, jobs per resident, and rates of calls for police and emergency services—these variables accounted for very little of the disparity in charging rates. *Id.* at 39–40.

Policing practices, however, differed starkly between majority-Black and majority-white neighborhoods, likely catalyzing disparities at later stages of the criminal legal process. For instance, 72% of the traffic stops police made in Black neighborhoods were low-priority, targeting infractions like broken taillights or expired tags rather than moving violations that implicated public safety; in white neighborhoods, just 48% of stops were low-priority. *Id.* at 42, 44. Additionally, police themselves initiated more stops in Black neighborhoods relative to white neighborhoods, where more enforcement actions started with citizens' calls for service. *Id.* at 45–46. These findings suggest that residents of majority-Black neighborhoods already face police stops at a lower threshold of suspicion. As discussed below, overreliance on ShotSpotter, which is mostly deployed in majority-Black neighborhoods, would only worsen that pattern.

2. Disparities in policing practices have contributed to stark racial disparities in wrongful convictions.

Racial disparities in policing practices can have devastating consequences. Thousands of exonerations in recent decades, many by DNA evidence, have revealed stark racial disparities in the risk people face of being wrongfully

convicted. A 2022 report by the National Registry of Exonerations, surveying the Registry's database of known wrongful convictions in the United States since 1989, found that Black people accounted for 53% of 3,200 exonerations documented at the time, despite comprising just 13.6% of the country's population. Samuel R. Gross et al., National Registry of Exonerations, *Race and Wrongful Convictions in the United States* 1 (2022), *available at* https://www.law.umich.edu/special/exoneration/Documents/Race%20Report%20Preview.pdf (last accessed July 1, 2024).[10] It is impossible to assess the true number of wrongful convictions, of which known exonerations necessarily represent only a subset.[11] But available exoneration data indicate that innocent Black people are more than seven times as likely as innocent white people to be convicted of murder, roughly eight times as likely to be convicted of sexual assault, and fully 19 times as likely to be convicted of drug offenses. *Id.* at 3–4, 18, 45.

[10] Permanent link at https://perma.cc/H4H9-ZUFL.

[11] As the Registry's report notes, "[m]ost innocent defendants with relatively light sentences probably never try to clear their names," instead "serv[ing] their time and do[ing] what they can to put the past behind them." *Id.* at 30. The vanishingly small number of known exonerations for misdemeanors and low-level felonies—despite those offenses comprising a large share of convictions—corroborates this. *Id.* Similarly, for innocent defendants who plead guilty, the relative lack of investigation, evidence presented, and record-keeping compared to trial cases makes it harder to seek exoneration. *Id.* And in all cases, legal hurdles to postconviction relief are high. *See id.*

Policing practices have contributed to these disparities. Because "[a]nybody who is subject to" a search during a traffic or street stop "is at risk of false arrest and possibly false conviction[, t]he issue is who police choose to search." *Id.* at 34. Where, as in Pittsburgh, police disproportionately choose to stop, search, arrest, and charge Black residents—at rates beyond what is explainable by variables that predict actual crime rates—such practices create not just a heightened risk of wrongful conviction, but one that is racially skewed.

3. ShotSpotter's disproportionate deployment in Black and brown neighborhoods risks exacerbating existing racial disparities.

ShotSpotter, as it has been deployed, is poised to worsen rather than ameliorate these disparities. SoundThinking has long hidden the exact locations of its sensors, even from its law enforcement customers. *See* Dhruv Mehrotra & Joey Scott, *Here Are the Secret Locations of ShotSpotter Gunfire Sensors*, Wired (Feb. 22, 2024), *available at* https://www.wired.com/story/shotspotter-secret-sensor-locations-leak/ (last accessed July 1, 2024). However, data about the locations it identifies in alerts can act as a proxy for ShotSpotter coverage areas, because the sensors are only effective over limited distances. Todd Feathers, *Gunshot-Detecting Tech Is Summoning Armed Police to Black Neighborhoods*, Vice (July 19, 2021), *available at* https://www.vice.com/en/article/88nd3z/gunshot-detecting-tech-is-summoning-armed-police-to-black-neighborhoods (last accessed July 2,

2024).[12] A 2021 investigation by *Vice*, examining ShotSpotter alert locations in four cities, indicated that sensors were overwhelmingly placed in majority-Black neighborhoods. *Id.*

More recently, leaked documents from SoundThinking with exact sensor locations have emerged, confirming *Vice*'s analysis. *Wired* obtained and analyzed a spreadsheet showing the precise locations of 25,580 sensors. Mehrotra & Scott, *supra*. It found that "nearly 70 percent of people who live in a neighborhood with at least one SoundThinking sensor identified . . . as either Black or Latine." *Id.* Additionally, "[n]early three-quarters of these neighborhoods are majority nonwhite." *Id.* Where ShotSpotter is deployed, and where police rely on it without additional evidence for reasonable suspicion, residents might face detention or arrest every time a car backfires nearby or a neighbor uses a nail gun for home repairs. Both the *Vice* and *Wired* reports show that those who bear the brunt of this risk are disproportionately people of color. Given the existing evidence, discussed above, that police already disproportionately target Black and brown people for stops, this likely effect of ShotSpotter is especially troubling.

C. Courts Have Recognized That Reasonable Suspicion Requires Scrutiny of ShotSpotter's Reliability, or Else It Will Likely Lead to Unjustified Over-Policing of Innocent People.

[12] Permanent link at https://perma.cc/Z4G6-NPAU.

At least one court has already recognized the need to probe ShotSpotter's reliability for purposes of reasonable suspicion. The Appellate Court of Illinois recently upheld a trial court order requiring SoundThinking to produce records related to ShotSpotter's reliability in response to a defense subpoena. *Jones*, 220 N.E.3d at 487–88. These records, the court held, were relevant because Jones had sought them mainly "in anticipation of filing a motion to suppress the traffic stop" on reasonable suspicion grounds. *Id.* at 486. Noting that third-party information justifying a stop "must bear some indicia of reliability," the court determined that the records sought bore on "whether ShotSpotter, as a system, is reliably able to identify gunfire and direct police to the firearms that caused it." *Id.* at 486–87 (quoting *People v. Maxey*, 949 N.E.2d 755, 766 (Ill. App. 1st Div. 2011)).

Courts have also stated that ShotSpotter alerts alone, without other evidence to corroborate the occurrence of gunfire or identify a specific suspect, do not supply reasonable suspicion. The Seventh Circuit, upholding a stop based in part, but not wholly, on ShotSpotter, stated that "ShotSpotter, standing on its own, should not allow police officers to stop a vehicle in the immediate vicinity of a gunfire report without any individualized suspicion of the vehicle." *United States v. Rickmon*, 952 F.3d 876, 881 (7th Cir. 2020). Recently, the District of Columbia Court of Appeals agreed: it held that a ShotSpotter alert—uncorroborated, as here, by any witness statements, 911 calls, or other evidence of gun activity—did not

supply reasonable suspicion to stop a cyclist. *Mitchell v. United States*, —A.3d—, No. 20-CF-0073, 2024 WL 2064628, at *4 (D.C. Ct. App. May 9, 2024). Crucially, the court recognized how broad the scope of suspicion would be if ShotSpotter on its own were enough: "[I]f reasonable articulable suspicion existed to stop Mr. Mitchell that evening on the basis that ShotSpotter alerted nearby and [he] was present, it would be legally permissible to stop almost the entire universe of people who happened to be in the neighborhood. That cannot be so." *Id.* Yet that is exactly the kind of sweeping suspicion the Commonwealth asks for here. Permitting it would inevitably result in stops and arrests of innocent people.

Indeed, ShotSpotter has already led to arrests of people whose cases were later dismissed for lack of evidence—but not before they endured unjustified, sometimes lengthy, incarceration. *See Williams v. City of Chicago*, No. 22-cv-3773, 2023 WL 6388891 (N.D. Ill. Sept. 29, 2023) (class action lawsuit whose named plaintiffs each allege wrongful ShotSpotter-based arrest). In Chicago, for instance, Michael Williams was arrested based on a ShotSpotter alert, accused of shooting a man who had asked him for a ride. *Id.*; Garance Burke et al., *How AI-powered tech landed man in jail with scant evidence*, Associated Press (Mar. 5, 2022), *available at* https://apnews.com/article/artificial-intelligence-algorithm-technology-police-crime-7e3345485aa668c97606d4b54f9b6220 (last accessed July 2, 2024). Yet when his attorneys challenged the alert, prosecutors "abandoned the ShotSpotter

evidence and dismissed the case" rather than respond to the challenge. Amended Civil Rights Class Action Complaint for Declaratory and Injunctive Relief and for Damages at 4–5, *Williams v. City of Chicago*, No. 22-cv-3773 (N.D. Ill. Nov. 14, 2022). But by then, Williams had spent nearly a year in jail. Burke et al., *supra*.

If police continue to rely too heavily on ShotSpotter, as they did in *Williams* and here, such miscarriages of justice will proliferate. But this Court has the chance to prevent them; it should do so.

CONCLUSION

ShotSpotter should not permit police to stop anyone they encounter on the scene of an alert. It yields evidence of gun crimes too infrequently, and issues alerts for too much innocuous conduct, to constitute reliable evidence of a crime without additional evidence. Allowing detentions on such thin evidence erodes the presumption of innocence, subjecting residents of neighborhoods with ShotSpotter to reduced constitutional protections. Because those neighborhoods disproportionately house people of color, overreliance on ShotSpotter would perpetuate, even worsen, existing racial disparities in policing practices. Technological tools are not inherently reliable; neither are they inherently unbiased, objective, or fair. Deployed without adequate empirical validation or assessments of potential bias, they can contribute to wrongful arrests and deepen longstanding inequities. ShotSpotter is one such unvetted, unvalidated, and

unreliable tool that has been deployed in inequitable ways. This Court should not let it be a pretext for unconstitutional stops and a driver of wrongful convictions.

Respectfully submitted,

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CERTIFICATION OF WORD COUNT

I, Elizabeth A. DeLosa, hereby certify the foregoing Amicus Brief was prepared using Microsoft Word, Times New Roman font, and 14-point typeface. Exclusive of the title page, tables of contents and authorities, and the various attached certificates, the brief contains 6,987 words.

/s/ Elizabeth A. DeLosa

Date: July 5, 2024

RULE 127 CERTIFICATE OF COMPLIANCE

I certify that this filing complies with the provisions of the *Public Access Policy of the Unified Judicial System of Pennsylvania: Case Records of the Appellate and Trial Courts* that require filing confidential information and documents differently than non-confidential information and documents.

/s/ Elizabeth A. DeLosa

Date: July 5, 2024

CERTIFICATE OF SERVICE

I hereby certify that on this 5th day of July 2024, a true and correct copy of the foregoing was served on counsel of record via PACFile.

/s/ *Elizabeth A. DeLosa*