EXHIBIT A

2020-P-1334

Commonwealth of Massachusetts Appeals Court

COMMONWEALTH

vs.

LINCOLN FORD

BRIEF FOR AMICI CURIAE RODERICK & SOLANGE MACARTHUR JUSTICE CENTER AT NORTHWESTERN PRITZKER SCHOOL OF LAW AND INNOCENCE PROJECT, INC. IN SUPPORT OF DEFENDANT-APPELLEE AND AFFIRMANCE

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2

CORPORATE DISCLOSURE STATEMENT

Pursuant to Rule 17(c)(1) and Supreme Judicial Court Rule 1:21, *amici* state as follows:

Roderick & Solange MacArthur Justice Center is a 501(c)(3) non-profit organization. It has no parent corporation and no publicly-held corporation owns 10% or more of its stock. Its Illinois Office is affiliated with Northwestern Pritzker School of Law.

Innocence Project, Inc. is a 501(c)(3) non-profit organization. It has no parent corporation and no publicly-held corporation owns 10% or more of its stock.

3

TABLE OF CONTENTS

TABLE OF AUTHORITIES

Cases

Constitutional Provisions

Other Authorities

8

9

INTEREST OF AMICI[1]

Amicus curiae Roderick & Solange MacArthur Justice Center ("MJC") is

a civil rights organization that focuses on injustices in the criminal legal

system, including the consequences of faulty investigative methods. MJC's

Illinois Office, which is affiliated with Northwestern University's Pritzker

School of Law, has done original research showing that ShotSpotter alerts

rarely lead police to find evidence of gun crime in response—research that was

recently confirmed and expanded by the City of Chicago's Office of Inspector

General.

Amicus curiae Innocence Project, Inc. works to reverse and prevent

wrongful convictions and miscarriages of justice. The Innocence Project has

decades of expertise on the use and misuse of forensic methods in the criminal

legal system and has participated in litigation and public education concerning

the reliability of numerous investigative tools, including ShotSpotter.

Amici file this brief to provide the Court with information about

ShotSpotter's technology, the lack of evidence of its reliability, and its role in

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[1] No party or party's counsel authored this brief in whole or in part. No party, party's counsel or person other than *amici curiae* contributed money to fund preparing or submitting this brief. *Amici* and their counsel have never represented one of the parties to this appeal and are not parties to any proceeding or legal transaction at issue in this appeal. *See* Mass. R. App. P. 16(c)(5).

10

police investigatory stops. This perspective is relevant to the constitutional questions raised in this appeal, including whether a ShotSpotter alert can factor into the determination of reasonable suspicion to effectuate an investigatory stop and whether ShotSpotter-initiated police stops warrant especially careful scrutiny.

SUMMARY OF ARGUMENT

This case presents this Court with the opportunity to make clear that, in the absence of necessary testing and validation, alerts from the ShotSpotter gunshot detection system should not be given any weight when determining whether there was reasonable suspicion to justify a police stop under the Fourth Amendment and Article XIV of the Massachusetts Declaration of Rights. There is no scientific evidence that ShotSpotter can reliably distinguish the sound of gunshots from other urban noises. Neither ShotSpotter nor anyone else has published any studies demonstrating how often the system is fooled by innocuous loud sounds like engine backfires, construction noises, and fireworks. Without competent testing, there is no basis to trust that a ShotSpotter alert is a reliable signal of actual gunfire. [pp. 12–27] Moreover, a recent assessment by the Office of Inspector General in Chicago of ShotSpotter's performance in the field shows that the vast majority of alerts do not lead police to find any evidence of a gun, let alone gunfire. Nevertheless,

ShotSpotter alerts are routinely used by police to justify stops and searches.[2]

[pp. 27–30]

When courts review the constitutionality of an investigatory stop that

follows a ShotSpotter alert, they should both eliminate ShotSpotter from their

consideration of the circumstances [pp. 31–36, 39–42] and be especially careful

to scrutinize the remaining factual basis for police action [pp. 36–39].

ShotSpotter alerts prime officers to expect danger and believe that shots were

just fired, which may lead officers to interpret otherwise innocuous behavior as

confirmation of the ShotSpotter system's unreliable alert. Courts assessing the

constitutionality of a stop should thus be especially attentive to the objective

circumstances—independent of the ShotSpotter alert—in determining whether

a seizure was justified. [pp. 31–42]

ARGUMENT

I. THE SHOTSPOTTER SYSTEM IS SUBJECTIVE, UNVALIDATED, AND UNRELIABLE.

ShotSpotter is marketed as a tool to identify gunfire and its location so

that police can quickly dispatch officers to investigate. The system sends alerts

to officers—often directly to an app on their mobile devices—telling them that

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[2] City of Chicago Office of Inspector General, The Chicago Police Department's Use of ShotSpotter Technology (Aug. 2021) ("Chicago OIG Report"), https://igchicago.org/wp-content/uploads/2021/08/Chicago-Police-Departments-Use-of-ShotSpotter-Technology.pdf

12

gunshots were fired in a particular location, plotted with a pin on a map. The

system has the look and feel—and marketing—of highly precise technology. A

look under the hood, however, reveals a fundamentally subjective and untested

system.

A.   ShotSpotter's gunshot detection system is fundamentally subjective.

ShotSpotter is a network of microphones that are typically installed on

poles or rooftops and are always listening and recording. These microphones,

which are paired with simple audio-processing circuitry and a cell-network

connection, are calibrated to detect "impulsive noise[s]"—"any noise that goes

bang, boom or pop"[3]—and send audio snippets of the noise to ShotSpotter's

cloud computing system.[4] The audio snippets sent from each sensor contain

the loud noise that triggered the sensor plus one second of audio before and

after. A ShotSpotter employee has testified that the triggering sounds "could be

anything"[5] with a "sharp enough rise in time . . . and a rise in amplitude,"

including firecrackers, loud trucks, and construction equipment.[6]

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[3] Testimony of Paul Greene, ShotSpotter Manager of Forensic Services, at 25:16-26:8, *California v. Reed*, No. 16015117 (Cal. Super. Ct. S.F. County July 5–6, 2017) ("Greene Testimony in *Reed*") (testimony of ShotSpotter employee at *Frye* hearing in criminal case). *Amici* would be glad to provide the Court or parties with copies of any sources cited herein upon request.

[4] Greene Testimony in *California v. Reed*, at 14:8-15:16.

[5] *Id.* at 25:16-26:8.

[6] *Id.* at 113:19–114:2.

ShotSpotter relies on an unvetted computer algorithm and the subjective

impressions of human reviewers to trigger alerts. Audio snippets sent from

microphones are first run through secret, proprietary audio-screening

algorithms that make a first attempt at classifying the noise—as fireworks,

helicopter, gunshot, etc.[7]—and determining its location. [8] The software does

not make the final decision to send out an alert. Instead, it is call-center style

staff, working in offices in Newark, California and Washington, DC,[9] who

listen to the disembodied audio snippets passed along from the software

algorithm and decide, based on their subjective impression of the sound and a

visual waveform generated by the software, whether to trigger an alert.[10]

ShotSpotter's operators are not forensic audio experts; they can be hired

with only a high school diploma and, as detailed below, whatever on-the-job

training or proficiency testing they may receive from ShotSpotter is shrouded

in secrecy.[11] Even the basic guidelines that these operators are supposed to

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[7] *Id.* at 25:16–26:13, 113:19–114:2.
[8] *Id.* at 14:8–15:16; Chicago OIG Report, at 4 ("The ShotSpotter system approximates the location of the possible gunshots [using] techniques for computing the source location of a sound based on the time of arrival and angle of arrival of sound waves at multiple surrounding sensors.").
[9] Chris Mills-Rodrigo, *Gunshot Detection Firm ShotSpotter Expands With New D.C. Office*, The Hill (July 14, 2021), https://thehill.com/policy/technology/563028-gunshot-detection-firm-shotspotter-expands-with-new-dc-office.
[10] Chicago OIG Report, at 4.
[11] *See infra* 19–20 & n.30.

follow are treated as trade secrets and have never been independently vetted or publicly analyzed—something that is also true with respect to the algorithmic screening tool.[12]

If a ShotSpotter operator labels a noise as a gunshot or "possible gunshot," an alert is forwarded directly to the police department. ShotSpotter operators can and do issue alerts for noises that the computer initially flagged as non-gunshots.[13] The operators' review lasts mere seconds; the entire process—from initial noise detection through alert to police—typically happens in less than one minute.[14]

Police receive alerts directly on proprietary ShotSpotter apps on their computers, as well as mobile phones and tablets in the field.[15] These apps obscure any trace of the subjective nature of the ShotSpotter operator's determination. Instead, the apps present officers with a display that conveys digital objectivity, showing the number of (supposed) gunshots and a (seemingly) precise location indicated with a single pin on a street-view map,

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[12] *See infra* 19–20 & nn. 32–34.

[13] Greene Testimony in *California v. Reed*, at 15:19–16:9, 153:23–154:24.

[14] ShotSpotter, ShotSpotter Respond Q&A (Dec. 2020), https://www.shotspotter.com/wp-content/uploads/2020/12/ShotSpotter-Respond-FAQ-Dec-2020.pdf.

[15] Chicago OIG Report, at 7; ShotSpotter, ShotSpotter Mobile https://www.shotspotter.com/shotspotter_mobile/.

15

along with a link to the audio snippets.[16] Responding officers rely on this

information to chase after the supposed gunfire.

B. ShotSpotter's methods of distinguishing gunfire from other loud noises are not validated and are shrouded in secrecy.

Every stage of ShotSpotter's gunshot detection process—from the initial

sound detection through the algorithmic processing to the operator's decision

to send an alert—is unvetted and shot through with opportunities for error.

ShotSpotter itself acknowledges some of these weaknesses, and there is

compelling independent evidence for others. Still, ShotSpotter fights to keep

key parts of its system secret, such that it is impossible to independently vet

parts of the system for flaws that may well lead it to systematically send alerts

for noises that are not gunfire—even though every false alert tees up a high-

intensity police encounter with innocent people who happen to be in the

vicinity.

First, the very premise upon which ShotSpotter is built—that its

microphones can reliably detect, distinguish, and locate the sound of gunfire in

urban environments—is dubious. A ShotSpotter engineer has acknowledged

that the system works less effectively in the urban settings in which it is most

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[16] Greene Testimony in *California v. Reed*, at 30:20–31:15.

often deployed.[17] This is because gunshot detection and locational accuracy are

sensitive to the complexities of the built environment.[18] A peer-reviewed audio

engineering study explains that "discriminat[ing] if the signal corresponds to

an actual gunshot or if it constitutes a different type of high-amplitude impulse

sound" is "very susceptible to environmental issues such as background noise,

acoustic multipath, and [non-line-of-sight] condition."[19] The study describes

the close acoustical similarity of gunshots to other noises like fireworks and

observes that "[t]he false positive activation rate fluctuates significantly from

one system installation to another."[20] In official documents, ShotSpotter

acknowledges these limitations. The "Detailed Forensic Reports" that

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[17] Testimony of R. Calhoun, ShotSpotter Engineer, at 36:21–37:3, *People v. Durham*, No. 11-1078 (N.Y. County Ct. Rensellaer County Mar. 24, 2012) ("Calhoun Testimony").

[18] Juan R. Aguilar, *Gunshot Detection Systems in Civilian Law Enforcement*, 63 J. Audio Eng. Soc'y 280, 281–82 (2015).

[19] *Id.* at 284–85.

[20] *Id.* at 287. The study reports that false-positive values "between 15 and 58% can be found" and that "the most reported source of failed activations is noise from small explosives such as fireworks, which exhibit a rate of about 54% or more." *Id.* These figures pertain to a different gunshot detection system. ShotSpotter has never published similar empirical studies examining its false positive rate, nor does it test its installations in particular cities for false positives. *See* Jillian B. Carr & Jennifer L. Doleac, *The Geography, Incidence, and Underreporting of Gun Violence: New Evidence Using ShotSpotter* 5 (Apr. 2016), https://www.brookings.edu/wp-content/uploads/2016/07/Carr_Doleac_gunfire_underreporting.pdf; *infra* § I.C.

17

ShotSpotter issues to prosecutors (well after the real-time alert) warn that

ShotSpotter cannot guarantee "100% detection," due to interference from

"buildings, topography, foliage, periods of increased traffic or construction

noise, and other urban acoustic noises."[21] ShotSpotter's contracts with cities

also acknowledge that the system mistakes fireworks for gunshots, warning

customers that around New Year's and Independence Day—when there are

large amounts of fireworks—the system is put into a "fireworks suppression

mode" that may result in more frequent failure to alert to actual gunshots.[22]

Second, there is evidence that the ShotSpotter software algorithm is

unreliable. ShotSpotter has never published or shared its algorithm with

independent experts. ShotSpotter has sometimes admitted that the algorithm

makes mistakes. A high-level ShotSpotter employee testified in 2017 that out

of the over 700 ShotSpotter alerts he had reevaluated for forensic purposes, he

had to make corrections to one-half to two-thirds of the initial, real-time data

reported.[23] One court concluded, after hearing such testimony, that

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[21] ShotSpotter, Detailed Forensic Report (example),
https://www.shotspotter.com/wp-content/uploads/2019/05/DFR-Example-.pdf.

[22] *See, e.g.*, Chicago Police Department, ShotSpotter Inc. Contract, at 96
(effective Aug. 20, 2018) ("Chicago ShotSpotter Contract"),
https://webapps1.chicago.gov/vcsearch/city/vendors/102512086A/contracts

[23] Greene Testimony in *California v. Reed*, at 104:16–104:23, 112:22–113:18.
ShotSpotter's employee testified that corrections can include changes in time
stamps due to failure to detect a fired gunshot or the accidental detection of an

18

"ShotSpotter's computer software cannot accurately distinguish between various types of impulsive sounds that have characteristics similar to a gunshot, for example, firecrackers or backfire noise from a car."[24]

ShotSpotter also has acknowledged that its algorithm can make incorrect determinations about the location of supposed gunshots. The same ShotSpotter employee testified that alerts he reviews in post-processing often require a correction in location.[25] ShotSpotter admits incidents can be "significantly mislocated,"[26] and select instances have been reported as off by distances such as 450 meters,[27] 1,000 meters,[28] and one mile.[29]

Third, there is no public evidence about whether the operators who vet the audio snippets passed along from the software algorithm can reliably

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echo or "other spurious noises" that were not gunshots. *Id.* at 12:8–13:5, 113:16–18.

[24] Tr. at 4054:6-9, *California v. Gillard*, No. 05-164044-0 (Cal. Super. Ct. Contra Costa County June 2, 2014) (oral ruling on *Kelly-Frye* motion challenging ShotSpotter evidence); *accord* Tr. at 9:15-19, *California v. Gillard*, No. 05-141209-7 (Cal. Super. Ct. Contra Costa County Feb. 10, 2017).

[25] Greene Testimony in *California v. Reed*, at 113:7–18.

[26] Testimony of Paul Greene, at 113:7–25, *People v. Simmons*, No. 2016-0404 (N.Y. County Ct. Monroe County Oct. 17, 2017).

[27] Greene Testimony in *California v. Reed*, at 227:3–14.

[28] Testimony of Paul Greene, at 229:19-230:3, *In re J. Blackshell et al.* (grand jury transcript, Monroe County, N.Y. Sept. 18, 2015)

[29] Garance Burke, et al., *How AI-Powered Tech Landed Man in Jail With Scant Evidence*, Assoc. Press (Aug. 19, 2021), https://apnews.com/article/artificial-intelligence-algorithm-technology-police-crime-7e3345485aa668c97606d4b54f9b6220.

classify sounds as gunfire. ShotSpotter's operators are not forensic experts;

minimum posted job requirements include little more than a high school

diploma and customer service experience.[30] Little is known about the training

they receive. ShotSpotter recently told journalists that it "has a two-month,

four-phase training program,"[31] but to *amici's* knowledge, the company has

never disclosed the detailed content of this training program or, crucially,

whether (and, if so, how) it tests operators for proficiency at distinguishing

gunfire from known samples of confounding noises like engine backfires. The

system relies fundamentally on these operators, yet neither police nor courts

know how well they distinguish gunshots from other sounds.

ShotSpotter also fights aggressively to keep key elements of its operator

protocols secret, including the central guidance that operators follow, entitled

Classification Continuum: *Decision-Making Guidelines for Real Time Incident Review*.

That document, according to ShotSpotter, "summarizes the key considerations

that a reviewer should weigh in evaluating whether a given noise even was a

gunshot—as opposed to, for instance, a firework, backfiring truck, or

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[30] ShotSpotter, Incident Review Center Specialist – Hiring All Shifts – FT/PT, https://www.shotspotter.com/career/service-operations-center-specialist-hiring-all-shifts-ft-pt/; Greene Testimony of July 6, 2017, at 154:27–155:4.
[31] *See* Statements provided by ShotSpotter in response to questions submitted by the Associated Press (Aug. 12, 2021), available at https://www.documentcloud.org/documents/21045566-shotspotter-responses-to-the-associated-press; *see also* Burke, et al., *supra* note 29.

helicopter."[32] But, despite its centrality in understanding the system's operation

and reliability, ShotSpotter has gone to great lengths to keep the protocol

confidential, opposing disclosure on supposed trade secrecy grounds rather

than opening it to scientific scrutiny.[33] As it stands, the only people who have

apparently seen the protocol either work for ShotSpotter or are subject to

discovery protective orders prohibiting its public discussion. A forensic audio

expert who examined the protocol on behalf of a criminal defendant publicly

opined that "the document should be provided to anyone who deals with

ShotSpotter systems so that the highly subjective nature of the gunshot

determination is understood by those who use the information in the criminal

justice system."[34]

There is reason to believe that ShotSpotter's human operators regularly

send alerts to police in response to sounds that are not gunfire. ShotSpotter's

contracts with cities explicitly state that it will send alerts to police not just

when there is "[h]igh confidence [that an] incident is gunfire," but also when it

is "uncertain if [an] incident is gunfire or not."[35] In other words, ShotSpotter

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[32] ShotSpotter Opp. to Mot. to Amend Protective Order at 2, *State v. Williams*, 20 CR 0899601 (Ill. Cir. Ct. Cook County May 28, 2021).

[33] *Id.* at 3–6.

[34] Amended Mot. to Modify the ShotSpotter Protective Order at 5, *State v. Williams*, 20 CR 0899601 (Ill. Cir. Ct. Cook County May 10, 2021).

[35] Chicago ShotSpotter Contract, at 96.

dispatches police in response to "possible gunfire" that ShotSpotter itself admits is "uncertain."[36]

ShotSpotter also has a strong contractual incentive to over-report sounds as gunfire. ShotSpotter's contracts promise to send alerts in response to at least 90% of outdoor, unsuppressed gunshots fired from greater than .25 caliber weapons inside the coverage area.[37] Crucially, however, the contracts make no corresponding guarantee to keep false alerts triggered by non-gunfire noises below any threshold.[38] Thus, contractually, ShotSpotter has no responsibility to avoid dispatching police in response to noises that are not gunfire, but has a strong incentive to over-report noises as gunfire in order to reduce the risk of "missing" a gunshot.

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[36] *Id.*
[37] *Id.* at 95–96, 99.
[38] *Id.*

22

Finally, the apps that ShotSpotter has created to communicate its alert to police mask all this subjectivity and potential error. Officers who were surveyed in a ShotSpotter-commissioned study confirm that a ShotSpotter alert makes them "pretty damn sure" they are going on a gun call, suggesting that they are in the dark about the fundamentally subjective nature of the system.[39]

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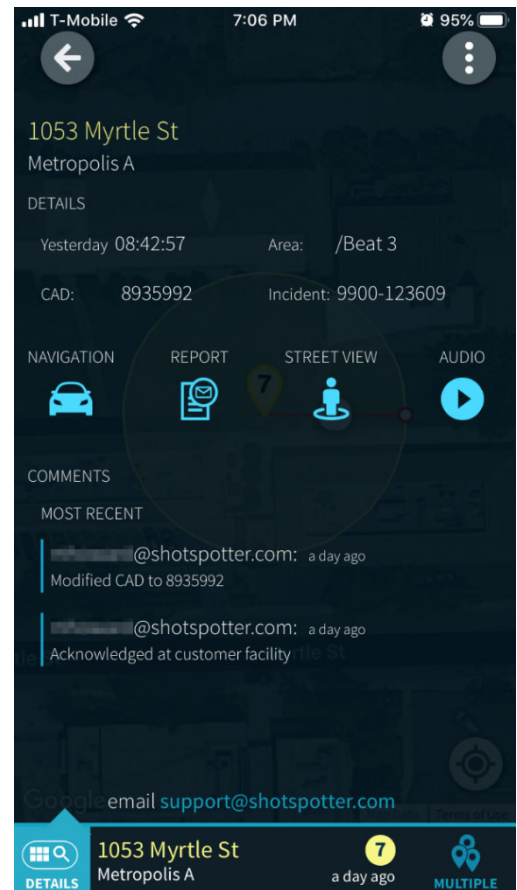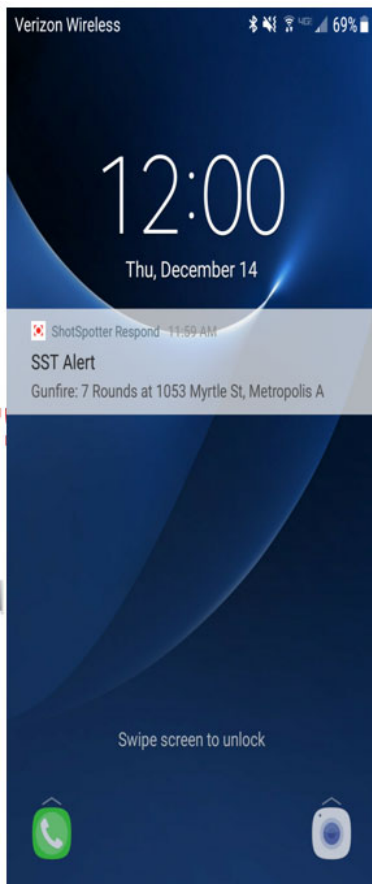
[39] Nick Selby, ShotSpotter Gunshot Location System Efficacy Study, CSG Analysis at 23 n.20 (July 8, 2011), https://njdc.info/wp-content/uploads/2017/10/Shot-Spotter-Gunshot-Location-System-Efficacy-Study.pdf.

Indeed, screenshots of ShotSpotter's mobile app, shown above, communicate

no hint of uncertainty to responding officers.[40]

> ### C. There are no published studies or data examining how frequently ShotSpotter sends alerts in response to sounds that are not gunfire.

Given the serious questions about ShotSpotter's reliability, one might

expect that ShotSpotter would seek to put them to rest by releasing data or

publishing studies testing its system's ability to reliably distinguish gunfire from

other sounds. It has *never* done so. Nobody has ever tested the system to see

how frequently it sends alerts for sounds that are not gunfire,[41] and we are

aware of no city that has tested its particular ShotSpotter installation for false

alerts—something that is crucial given that its results depend on how it is

implemented.[42] As a result, there is no empirical basis to conclude that a

ShotSpotter alert reliably reflects that a gunshot was actually fired at a specified

location.

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[40] The screenshots are copied from ShotSpotter's website and a PowerPoint presentation obtained by counsel from the Chicago Police Department through a Freedom of Information request.

[41] Carr & Doleac, *supra* note 20.

[42] A study of another gunshot detection system concluded that "once installed these systems must be continuously tested and checked, since new technical problems can emerge without warning and may be invisible to local personnel." Michael Litch & George A. Orrison, IV, *Draft Technical Report for SECURES Demonstration in Hampton and Newport News, Virginia* (2011), https://www.ojp.gov/pdffiles1/nij/grants/233342.pdf.

The only published testing on ShotSpotter looks exclusively at the rate of missed gunshots, or "false negative" alerts. In these studies, researchers test-fired guns and measured how frequently the system failed to send an alert. By their design, however, such studies cannot say anything about the false *positive* rate—*i.e.*, how frequently the system misclassifies innocuous sounds as gunshots. The main study, conducted in Redwood City, California more than twenty years ago, admits it has nothing to say about false positives.[43] There is no basis to extrapolate from these "missed gunshot" rates to any conclusion about how easily the system is fooled by non-gunshots. In fact, one way to ensure that a system has fewer false negatives (*i.e.*, missed gunshots), is to make it less discriminating, so that it sends alerts for more loud noises whether or not they are actually gunfire.

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[43] Lorraine Green Mazerolle, et al., *A Field Evaluation of the ShotSpotter Gunshot Location System: Final Report on the Redwood City Field Trial* (Nov. 1999), https://www.ojp.gov/pdffiles1/nij/grants/180112.pdf. The study was conducted in 1997 specifically to examine the "missed" gunshot rate and found that the system picked up around 80% of fired shots. The study's design diverged from "real-life situations" in that it "avoided heavy traffic hours" to limit "background noise," *id.* at 12; used blanks (not actual bullets), which register at lower amplitudes, *id.* at 11 n.8; and tested only one model of pistol, alongside a shotgun and an assault rifle, neither of which is common in cities, *id.* at 55. *Amici* are aware of only one other test, conducted in 2006 in a covered area at the Charleston Navy Yard. Like the Redwood City study, it employed test-fired gunshots to look only for false negatives. *See* Calhoun Testimony, at 38:7-39:22; Erica Goode, *Shots Fired, Pinpointed and Argued Over*, N.Y. Times (May 28, 2012).

25

For purposes of police officers responding to a ShotSpotter alert—and

the people they encounter on the streets—the false negative rate is completely

irrelevant. False negatives are immaterial to a responding officer because, by

definition, they do not produce an alert and therefore do not result in officers

being deployed in the first place. Instead, what matters to officers is how often

the ShotSpotter alerts to which they are responding are not actually gunfire--

i.e., how much stock officers should put in an alert as an indicator of actual

gunfire. No study has ever assessed that.

The complete lack of evidence about the rate of false positive alerts is

particularly striking because such testing is standard practice with respect to

any credible detection technology. Radar guns must be tested and calibrated to

ensure their speed readouts are accurate. Drug sniffing dogs must be tested and

certified to ensure that they alert only in response to the smell of illegal

substances. ShotSpotter systems have never been subjected to analogous

testing.

ShotSpotter's promotional materials claim a "97% aggregate accuracy

rate" and a "false positive rate of less than 0.5%."[44] But these marketing claims

are deeply misleading and scientifically meaningless. The figures are not based

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[44] ShotSpotter, ShotSpotter Respond Q&A (Dec. 2020)
https://www.shotspotter.com/wp-content/uploads/2020/12/ShotSpotter-Respond-FAQ-Dec-2020.pdf.

on actual testing of the system. Instead, ShotSpotter calculates these

"accuracy" figures by simply *assuming* that every alert was triggered by actual

gunfire unless it receives a voluntary error report from the police customer

flagging a mistake.[45] The figures are simply tallies of voluntary customer

complaints. The fallacy in these supposed "accuracy" statistics is obvious if

one considers how this methodology would apply to other investigative

methods: a radar gun would be deemed 100% "accurate" unless police officers

had voluntarily submitted error reports to the manufacturer complaining that

the speed reading seemed to differ from their eyeballed estimate.

These supposed "accuracy" numbers are especially meaningless when it

comes to assessing false alerts to non-gunfire. This is because police are neither

under any obligation to report such errors nor, more fundamentally, in a

position to know what noise actually triggered an alert. Officers who arrive at

the scene of a false alert will simply show up and find nothing; they typically

have no way to tell whether ShotSpotter was triggered by something like a

blown tire or fireworks, so they have no basis to report an error. Indeed,

officers may assume there *was* gunfire—even when there is no corroborating

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[45] Edgeworth Analytics, Independent Audit of the ShotSpotter Accuracy, at 2 (July 22, 2021) ("Information on potential errors relies on clients reporting those potential errors to ShotSpotter."), https://edgeworthanalytics.com/wp-content/uploads/2021/07/Shotspotter-Accuracy-Study.pdf. ShotSpotter commissioned this "independent audit." *Id.* at 1.

27

evidence—precisely because they have been trained to trust ShotSpotter, which relentlessly markets its misleading "97% accuracy" claim.

In Chicago, for example, police did not report a single false positive error back to ShotSpotter out of more than 20,000 alerts in the first six months of 2021.[46] They failed to report *any* false alerts even though, according to the city's Inspector General, 90.9% of ShotSpotter alerts led police to find no gun-related incident of any kind at the scene.[47] *See infra* Section II.D. Yet, according to ShotSpotter's methodology, the lack of police complaints would mean the system had a 0% false positive rate. That is a transparently misleading statistic.

ShotSpotter's supposed "accuracy" figures thus do not reflect the rate of actual false alerts. Indeed, ShotSpotter's reliance on customer-reported errors to derive "accuracy" claims only underscores its remarkable failure to do any scientifically meaningful testing.

D.   In practice, the vast majority of ShotSpotter alerts lead police to find no gun-related incident.

Field data from a number of cities show that, in practice, ShotSpotter alerts overwhelmingly fail to lead police to any gun-related incident. The

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[46] ShotSpotter, Chicago Performance Overview 2021, at 3 (documenting the number of "Reported False Positive Incidents" as zero), https://docs.google.com/presentation/d/1L6z5XpwVWL_YQJu4CiD55hxAm78bsGPg/edit#slide=id.p1.

[47] Chicago OIG Report, *supra* note 2, at 3.

Chicago Office of Inspector General's investigation into ShotSpotter looked at

over 50,000 ShotSpotter alerts over eighteen months and found that only 9.1%

led police to find "evidence of a gun-related criminal offense."[48] The OIG's

report echoed the findings of a 2021 study conducted by *amicus* MacArthur

Justice Center, which found that a similarly small proportion of ShotSpotter-

initiated dispatches in Chicago led police to any kind of gun-related incident.[49]

A study conducted by *Forbes* in 2016 analyzed data from more than two dozen

ShotSpotter cities and calculated that up to 70% of ShotSpotter alerts led police

to locations where they found no evidence of a gun crime.[50] A report from the

St. Louis Post-Dispatch indicates even higher rates of dead-end alerts, citing

research from criminologist Dennis Mares and St. Louis Crime Analysis Unit

head Emily Blackburn. They found that over a five-year period, only about one

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[48] Chicago OIG Report, *supra* note 2, at 3.

[49] *See* Brief of Chicago Community-Based Organizations as Amici Curiae, at 4–11, *State v. Williams*, No. 20 CR 099601 (Ill. Cir. Ct. Cook County May 3, 2021), https://endpolicesurveillance.com/documents/2021-05-03-Motion-for-Leave-to-File-Brief-as-Amici-Curiae-with-Ex.-A-Amicus-Brief-attached.pdf.; *see also* https://endpolicesurveillance.com. A 2017 investigation found similarly poor results. *See* Michael Wasney, *The Shots Heard Round the City*, Southside Weekly (Dec. 19, 2017), https://southsideweekly.com/shots-heard-round-city-shotspotter-chicago-police/.

[50] Matt Drange, *ShotSpotter Alerts Police to Gunfire, but Produces Few Tangible Benefits*, Forbes (Nov. 17, 2016), https://www.forbes.com/sites/mattdrange/2016/11/17/shotspotter-alerts-police-to-lots-of-gunfire-but-produces-few-tangible-results/?sh=6b6b4cc0229e.

percent of over 20,000 ShotSpotter alerts in the city yielded enough evidence,

like shell casings or witnesses, to lead to a police report of a supposed gunfire

incident.[51] These studies all demonstrate that police officers responding to a

ShotSpotter alert have no good reason to expect that they will find any kind of

gun-related incident at the scene. To the contrary, experience shows that they

will find nothing the vast majority of the time.

Peer-reviewed studies have attempted to assess ShotSpotter's on-the-

ground efficacy by examining whether the system's presence increases gun-

related arrests or reduces gun-related violence. The studies published to date

have found no effect, even while they find a marked increase in police

resources spent responding to supposed gunfire alerts.[52]

Every year, ShotSpotter sends out more than 200,000 alerts to police

nationwide.[53] In response, officers race into neighborhoods believing they are

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[51] Eric Heffernan, *St. Louis Technology Detects a Lot of Gunfire, but Calls Often Lead to a Dead End*, St. Louis Post-Dispatch (May 31, 2021), https://www.stltoday.com/news/local/crime-and-courts/st-louis-technology-detects-lots-of-gunfire-but-calls-often-lead-to-a-dead-end/article_882b0aa5-653c-5657-8410-bd8af2997e21.html.

[52] Dennis Mares & Emily Blackburn, *Acoustic Gunshot detection systems: A Quasi-Experimental Evaluation in St. Louis, MO*, J. Experimental Criminology (Jan. 20, 2021); Mitchell L. Doucette, et al., *Impact of ShotSpotter Technology on Firearm Homicides and Arrests Among Large Metropolitan Counties: a Longitudinal Analysis, 1999–2016*, J. Urban Health (Apr. 30, 2021).

[53] Edgeworth Analytics, Independent Audit of the ShotSpotter Accuracy, at 1.

30

chasing down gunfire. But the vast majority of those alerts will turn up nothing. And, remarkably, the responding officers—and reviewing courts— have no scientific basis to believe that the system reliably sends them after actual gunshots, as opposed to other loud noises.

II.   THE FEDERAL CONSTITUTION DOES NOT PERMIT SEARCHES OR SEIZURES BASED ON SHOTSPOTTER ALERTS.

Because ShotSpotter has never been properly tested and has a poor track record in practice, it cannot serve as a basis for police to develop reasonable suspicion or probable cause. All parties agree that a ShotSpotter alert on its own can never supply reasonable suspicion, but, given the substantial problems with its validation and reliability, a ShotSpotter alert also should have no probative value in judging whether the totality of the circumstances justified an investigatory stop. Moreover, because the ShotSpotter alert itself may improperly bias the perceptions of responding officers by priming them to regard otherwise innocuous circumstances and behaviors as confirmation of ShotSpotter's untrustworthy conclusion, courts should be especially careful to scrutinize whether the remaining facts (excluding the ShotSpotter alert) establish sufficient grounds for a stop.

31

A.   **The Fourth Amendment does not permit courts to consider a ShotSpotter alert as a basis for reasonable suspicion because ShotSpotter's system has never been tested for reliability and is shrouded in impermissible secrecy.**

ShotSpotter alerts should not be considered as part of the "totality of the circumstances" potentially justifying an investigatory stop or arrest because they do not have the indicia of reliability that the Fourth Amendment requires. *Alabama v. White*, 496 U.S. 325 (1990); *Illinois v. Gates*, 462 U.S. 213, 238 (1983). "Reasonable suspicion . . . is dependent upon both the content of information possessed by police *and its degree of reliability*." *White*, 496 U.S. at 330 (emphasis added, quotation omitted). Where police seek to rely on an investigative tool to develop cause for a stop or arrest, police must be able to "prove [its] reliability" so as to justify giving its results weight. *Florida v. Harris*, 568 U.S. 237, 245 (2013). ShotSpotter fails this test.

The Supreme Court has emphasized the centrality of proper reliability testing of investigative tools in the Fourth Amendment context. In *Florida v. Harris*, the Supreme Court considered whether a drug-sniffing dog's alert was sufficiently reliable to justify a search. 568 U.S. 237. The Court insisted that the dog's reliability should be assessed by looking at its performance in controlled, empirical tests which were "a better measure of a dog's reliability" than, for example, observational reports from officers in the field. *Id.* at 246. The Court gave a number of examples of adequate certification, all of which,

crucially, required that that the dog actually be tested for its "proficiency in locating drugs" in circumstances where "designers of an assessment know where drugs are hidden and where they are not." *Id.* The Supreme Court thus insisted on testing that would demonstrate that the dog could reliably identify and distinguish drugs from other smells.

This kind of empirical evidence of an investigative tool's reliability is central to the integrity of the Fourth Amendment. It is the absence of such empirical validation that explains why police cannot use the family dog to sniff for drugs or why they could not use soothsayers to identify and apprehend suspects. It is also why we insist that police test and calibrate speed guns, because otherwise there is no basis for police to rely on them to stop a car for speeding. *See, e.g.*, *Hall v. State*, 297 S.W.3d 294, 298 (Tex. Crim. App. 2009) (finding that LIDAR speed gun did not establish probable cause for speeding because there was no evidence it provided "reasonably trustworthy information").

For the same reason, police cannot use ShotSpotter as a basis to stop or arrest people. There are simply no controlled tests assessing how frequently ShotSpotter sends alerts to loud noises that are not gunfire. *Supra* 23–27. There is no testing of particular ShotSpotter installations—whether in Chelsea or Chicago—to see whether they perform to any reliability standard. *Id.* There is

also no publicly-known testing program assessing how frequently ShotSpotter's

human operators send out false alerts to non-gunfire—even though they, like

drug sniffing dogs, are entrusted with providing alerts to police. *Supra* 18–21.

As such, ShotSpotter utterly fails the standard of *Florida v. Harris.*

The "accuracy" claims that ShotSpotter touts in its marketing materials

are patently insufficient to permit police to rely on ShotSpotter to justify

investigatory stops. As explained, those figures simply *assume*—without any

empirical basis—that each and every ShotSpotter alert is accurate unless a

customer happens to file a voluntary error report. *Supra* 25–27. Such figures

reflect merely the instances where customers happen to file error reports and

reveal nothing about the system's actual performance in the field—*i.e.*, what

officers find at the scene of a ShotSpotter alert. *Id.* These misleading marketing

claims are plainly inadequate under the Supreme Court's reasoning in *Harris*,

which demands "controlled testing." 568 U.S. at 246.

ShotSpotter evidence cannot be used under the Fourth Amendment for

another critical reason: the secrecy that shrouds the system prevents defendants

from challenging its reliability. The Supreme Court in *Harris* emphasized that

"[a] defendant . . . must have an opportunity to challenge [the prosecution's]

evidence of a dog's reliability," for example by "contest[ing] the adequacy of a

certification or training program, perhaps asserting that its standards are too

lax or its methods faulty" or by "examin[ing] how the dog (or handler) performed in the assessments made in those settings." 568 U.S. at 247. In other words, the defendant must have an opportunity to see and oppose the evidence bearing on the reliability of the investigative tool.

ShotSpotter has not disclosed most of the basic documents and information essential to mount such a challenge. So far as *amici* are aware, ShotSpotter has never disclosed training or proficiency records regarding its operators, nor even the proficiency tests to which they are subject. *Supra* 18–21. Crucially, the fundamental protocol that ShotSpotter's operators use to designate a noise as a gunshot, the *Classification Continuum*, remains publicly unavailable. *Supra* 19–20. If ShotSpotter has ever done internal testing of its system for false positives, it has never described how it did so or shared those results. This intense secrecy renders ShotSpotter a black box to the public, courts, and criminal defendants. It deprives "a defendant [of] an opportunity to challenge such evidence of [the system's] reliability" and therefore runs afoul of the Fourth Amendment requirements articulated in *Harris*. 568 U.S. at 247.

Because there is no empirical evidence of ShotSpotter's false positive rate and because its methods and protocols are shrouded in secrecy, it would violate the Fourth Amendment to permit police officers to consider a ShotSpotter alert as evidence potentially establishing reasonable suspicion.

B.   The Fourth Amendment does not permit courts to consider a ShotSpotter alert as a basis for reasonable suspicion because of its poor results in the field and the scant information it provides.

ShotSpotter alerts must be disregarded when assessing the constitutionality of a seizure for another reason as well: their poor performance at leading police to actual gun-related incidents. "Reasonable suspicion, like probable cause, is dependent upon both the content of information possessed by police and its degree of reliability." *White*, 496 U.S. at 330. ShotSpotter fails on both scores.

As to reliability, it is now clear that ShotSpotter falls short based on the multiple, mutually-confirming studies of ShotSpotter's actual track record on the ground. For instance, as noted already, the Chicago Inspector General found that, nine times out of ten, police officers chasing ShotSpotter alerts find no gun crime. *See* Chicago OIG Report, at 3; *supra* 27–30. If a human informant were giving police officers dead-end tips nine times out of ten, a court would have no trouble simply dismissing those tips when determining whether a stop was justified. The same should be true for ShotSpotter. *See United States v. Rickmon*, 952 F.3d 876, 881 (7th Cir. 2020) ("[W]e conclude [ShotSpotter] is analogous to an anonymous tipster.").

As to the content of the information police receive, a ShotSpotter alert is far less detailed than what a typical human informant can provide. ShotSpotter

can never identify an actual person as a suspect. Unlike a drug detection dog or

a speed radar gun that is directed at an individual suspect, ShotSpotter can, at

best, identify the rough location of a sound that may (or may not) have been

gunfire. Moreover, police do not reach the location of the alert until some

minutes later, leaving plenty of time for people to arrive and depart the scene.

Furthermore, unlike an informant's call to 9-1-1, ShotSpotter can never narrate

events or provide a description of a suspect, vehicle, or other information

subject to corroboration by the responding officer. *Compare White*, 496 U.S. at

332 (emphasizing the "range of details" provided by an anonymous tipster and

"corroboration by police of . . . the informer's predictions" in finding the tip

could form part of the justification for a stop), *with Florida v. J.L.*, 529 U.S. 266,

268 (2000) (finding that "an anonymous tip that a person is carrying a gun is,

without more, [not] sufficient to justify a . . . stop and frisk").

The combination of ShotSpotter's demonstrated unreliability in the field

with the threadbare facts it offers police should lead this Court to reject it as

evidence potentially establishing reasonable suspicion.

C.   The Court should be especially skeptical of the factual basis for investigatory stops that result from ShotSpotter alerts because the technology biases the perceptions of responding officers.

In addition to disregarding ShotSpotter alerts when assessing the

constitutionality of a stop, courts should take an especially close look at

whether the surrounding circumstances, independent of the alert, were

sufficient to establish reasonable suspicion. This is because the seemingly high-

tech but unvalidated nature of ShotSpotter alerts will bias the perceptions of

responding officers, priming them to interpret otherwise benign circumstances

or innocuous behaviors as confirmation of the supposed gunshot reported by

ShotSpotter. Courts should recognize these biases and, as a corrective

measure, more closely examine the existence of reasonable suspicion in cases

where ShotSpotter dispatched police.

It is firmly established that people suffer from confirmation bias, a

phenomenon where individuals interpret information (or look for new

evidence) so as to conform with their pre-existing beliefs, assumptions or

expectations.[54] The effects of confirmation bias are an important consideration

in the context of investigatory stops where, as one court observed, "officers

may be more likely to perceive a movement as indicative of criminality if the

officer has been primed to look for signs that 'crime is afoot.'"[54]

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[54] Raymond S. Nickerson, *Confirmation Bias: A Ubiquitous Phenomenon in Many Guises*, 2 Review of General Psychology 175, 181 (1998); President's Council of Advisors on Science and Technology, Report to the President: Forensic Science in Criminal Courts: Ensuring Scientific Validity of Feature-Comparison Methods, at 31 (Sept. 2016).

[54] *Floyd v. City of New York*, 959 F. Supp. 2d 540, 580 (S.D.N.Y. 2013) (citing *Ligon v. City of New York*, 925 F. Supp. 2d 478, 530-31 (S.D.N.Y. 2013)); *see also* L. Song Richardson, *Cognitive Bias, Police Character, and the Fourth Amendment*, 44 Ariz. St. L.J. 267, 277–87, 291–93 (2012).

ShotSpotter creates this perceptual bias in responding officers, priming them to interpret what they see when responding to an alert as confirmation of the supposed gunshot. This effect is likely to be particularly strong because the design of ShotSpotter's interface communicates precision and objectivity. *Supra* 22. The subject matter of the alert is also highly charged: ShotSpotter tells officers that they are entering a volatile and potentially life-threatening situation where someone just fired a weapon. In these circumstances, any person who happens to be in the vicinity of the alert will be perceived as a potential threat. These expectations may lead officers to see danger in otherwise innocuous circumstances and to discount exculpatory context and clues.

The Chicago OIG's report confirms these fears. It documents instances where officers stopped and searched individuals simply because they were in the vicinity of a ShotSpotter alert.[55] The report also vividly illustrates the strongly biasing effects of ShotSpotter alerts: the OIG reviewed a random sample of stop-frisk reports that mentioned ShotSpotter and found that in 13.9% of those stops police officers had "cite[d] the frequency of ShotSpotter alerts in a given area as an element of the reasonable suspicion upon which an investigatory stop [was] predicated." In other words, the mere presence of *past*

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[55] Chicago OIG Report, at 16–22.

ShotSpotter alerts in an area led officers to perceive reasonable suspicion in circumstances where there otherwise was none.

Because of the powerful biasing effects of ShotSpotter alerts, reviewing courts should be especially careful to ensure that the surrounding facts independently justified police action.

III.   IT IS EVEN CLEARER UNDER ARTICLE XIV OF THE MASSACHUSETTS DECLARATION OF RIGHTS THAT SHOTSPOTTER ALERTS ARE NOT A PROPER BASIS FOR POLICE STOPS.

Article XIV of the Massachusetts Declaration of Rights affords defendants greater protections against police stops and arrests than the federal Constitution and more closely regulates surveillance technologies. The Massachusetts Supreme Judicial Court rejects the "totality of the circumstances" test used by federal courts as "unacceptably shapeless and permissive," *Commonwealth v. Upton*, 390 Mass. 562, 574 (1983), and instead applies the *Aguilar-Spinelli* standard which "provides more substantive protection to criminal defendants than… the Fourth Amendment," and comprises two separate tests: the "basis of knowledge" test and the "veracity" test. *Commonwealth v. Upton (II)*, 394 Mass. 363, 373 (1985). This framework governs determinations of both probable cause and reasonable suspicion, although "a less rigorous showing in each [prong of the test] is permissible" in

the latter context. *Commonwealth v. Depiero*, 473 Mass. 450, 454 (2016)

(quotation omitted).

The *Aguillar-Spinelli* framework is most commonly applied to assess

information provided by informants, but it readily governs other sources of

information, like ShotSpotter. In the informant context, the first prong—the

"basis of knowledge" test—assesses the circumstances underlying the

informant's report, while the second prong, the "veracity test," assesses the

circumstances supporting the informant's credibility. *See Commonwealth v.*

Alvarado, 423 Mass. 266 (1996). As applied to a system like ShotSpotter, the

"basis of knowledge" test looks to the information (*i.e.*, audio snippets of loud

noises) upon which ShotSpotter makes its determinations, while the "veracity"

test examines whether ShotSpotter reliably interprets that information.

ShotSpotter fails these tests.[56]

The basis of knowledge for a ShotSpotter alert consists of the audio

snippets of loud noises with associated timestamps and location information.

There is no public evidence that the quality of these recordings suffices to

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[56] The only cases in which Massachusetts courts have declined to apply some version of the *Aguilar-Spinelli* criteria concern information obtained from the registered motor vehicle (RMV) database, which are official state records whose reliability is presumed because of the circumstances of their creation. *See Commonwealth v. Ramos*, 88 Mass. App. Ct. 68, 71 (2015). ShotSpotter's gunshot determinations plainly do not fit within that exception.

reliably distinguish gunfire, nor that the audio collected in any particular

location will be of sufficient quality to do so. (Recall that cities do not test

ShotSpotter for false positives in general, let alone in particular locations.)

Moreover, ShotSpotter by its nature cannot provide any identifying details

about an individual person, unlike even an anonymous tipster. *Cf.*

Commonwealth v. Lyons, 409 Mass. 16, 20 (1990) (stop was unjustified where

police could only corroborate an anonymous informant's "description of the

automobile, the direction in which it was headed, and the race and gender of

the occupants" and had no corroboration of "the defendants' affairs" provided

by the caller).

Even if the raw information collected by the sensors were an adequate

"basis of knowledge," ShotSpotter utterly fails on the "veracity" prong of the

Aguilar-Spinelli test because the system has never been tested for false positive

alerts—*i.e.*, alerts in the absence of actual gunfire. Nor has ShotSpotter opened

its algorithm or operating protocols to scrutiny that could allow a Court to

examine the veracity of its reports. Evidence from the field shows that officers

responding to an alert will find no evidence of gun crime the vast majority of

the time. *See* Chicago OIG Report*,* at 3; *supra* 27–30 & nn. 49–52.

This Court should also reject ShotSpotter alerts as a basis for reasonable

suspicion in light of this Commonwealth's particular concern to preserve

42

constitutional protections in the face of new surveillance technologies. For

example, in cases where police have used cell-site data to support reasonable

suspicion or probable cause, the technology provided far more specificity than

ShotSpotter ever could, *e.g.*, a demonstrated link between an individual

criminal suspect's location with the location of the victim at the time of the

crime. *See Commonwealth v. Gosselin*, 486 Mass. 256, 257 (2020); *see also*

Commonwealth v. Augustine, 467 Mass. 230, 249 (2014) (interpreting Article XIV

to protect privacy in the face of novel cell-site location surveillance). Similarly,

Massachusetts courts have been careful to ensure that even new models of

familiar investigative tools like radar guns and breathalyzer tests are properly

scrutinized for reliability. *See Commonwealth v. Camblin*, 471 Mass. 639 (2015)

(breathalyzer); *Commonwealth v. Whynaught*, 377 Mass. 14 (1979) (radar gun).

Consistent with this tradition, the Court should not permit police to justify

investigatory stops on the basis of alerts from ShotSpotter's untested and

secretive system.

CONCLUSION

Because there has been no competent testing of ShotSpotter's system and

because of the other facts offered here, the Court should omit ShotSpotter

alerts from its consideration of whether there was reasonable suspicion for an

43

investigatory stop and scrutinize the remaining facts and circumstances

especially carefully.

Respectfully submitted,

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[57] Counsel thank student attorneys Navya Dasari, Ashley Fischer, and Ali Fraerman for their outstanding research and assistance preparing this brief.

44

CERTIFICATE OF COMPLIANCE

I hereby certify, under the pains and penalties of perjury, that this brief complies with the rules of the court that pertain to the filing of briefs, including those specified in Rule 16(k) of the Massachusetts Rules of Appellate Procedure. This brief complies with the type-volume limitation of Rule 20 because it contains 7,460 words, excluding the parts of the brief exempted by the rule. This brief complies with the type-style requirements of Rule 20 because it has been prepared in proportionally-spaced typeface using Microsoft Word 2016 in 14 point Calisto MT font.

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September 24, 2021

45

CERTIFICATE OF SERVICE

Pursuant to Mass. R.A.P. 13(e), I hereby certify that on September 24,

2021, I have made service of this Brief upon the attorneys of record for the

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