Article

The Life of a Gunshot: Space, Sound and the Political Contours of Acoustic Gunshot Detection

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Abstract

This article examines the implications of acoustic gunshot detection systems for the role of sound and nonhuman agencies in Surveillance Studies and their relationship to broader modes of power. This is done by examining the role of a ShotSpotter Flex Incident Report in the case of DeOnté Rawlings, a 14-year old black child shot and killed by an off-duty police officer in Washington, D.C. Through this case, this article traces the diagrams of power that imbricate this surveillance system within structural racism. In focusing on the material particularities of acoustical surveillance systems, like ShotSpotter Flex, this work also reconsiders the role of the visual in surveillance systems and Surveillance Studies. This article argues that these new configurations of sound and nonhuman agency offer a particular value to understanding the contemporary entanglement of surveillant mediums and broader regimes of power.

Introduction

ShotSpotter Flex, a surveillance system developed by SST, Inc., allows for the “pin point” detection of gunshots in urban areas. It relies primarily on a network of microphone arrays deployed on the rooftops around the area to be surveilled. The system is necessarily always listening. When the acoustical signature of a likely gunshot is heard by these microphone arrays, a chain of actions is set off within the system. First, the gunshot, as a sound, is identified by the algorithm in ShotSpotter’s software after being sent to SST’s servers. This information is then produced as a data point and overlaid on a map of the area. This is relayed to dispatchers, laptops in police squad cars, and, potentially, smartphones. The ShotSpotter Flex system has been claimed by SST, Inc. to locate a gunshot with an accuracy of within two feet from where the shot was fired depending on the number of sensors used (Petho et. al. 2013). The life of the gunshot does not end in this moment of detection and notification however. It lives on as it gets logged in a database. This becomes useable not only for crime statistics but also as means of creating a data trail of gunshot alerts and police responses. These crime statistics go on to produce risk models which then feedback into contemporary logics of surveillance and policing. Further, as we will see in the case of the DeOnté Rawlings shooting, the system itself also gets integrated into existing modes of power. Taken as a whole, the example of ShotSpotter Flex provides an opportunity for Surveillance Studies to not only move beyond its privileging of the visual, but also offers a deeper engagement with assemblage thinking and the technological nonhuman.

This paper provides an analysis of the actually existing parameters and implementation of the ShotSpotter Flex system so as to highlight the theoretical gap laid bare by acoustical gunshot detection. Acoustical gunshot detection systems proliferate, not only as a sensing technology like ShotSpotter Flex, but also on the battlefield in products developed by defence contractors Raytheon and Metravib among others. The use of acoustical sensing has a long history in modern warfare (from SONAR to signals intelligence and eavesdropping), whereas its use as a technology for urban surveillance by police, particularly in the case of ShotSpotter Flex, is relatively recent, having gained prominence in only the last decade. While the notion sensing can have a broad interpretation, I wish to focus here on sensing as both a means of perception and also as a physical, affective relation. ShotSpotter Flex also compels us to examine how the domain of the acoustical requires a re-evaluation of our understanding of the relationship of space to surveillance. This will become readily apparent as I examine how systems like ShotSpotter Flex begin to rely not on lines of sight, but the acoustical profiles of structures and events in space. The consequences of these changes and their intersections with ideologies of vision are integral to the flows of power exerted in the application of these technologies.

ShotSpotter Flex, and its emblematic status for a new domain of surveillance in the acoustical, offers the opportunity to explore the intersection and imbrication of algorithmic risk logics, as identified by Louise Amoore (2013), affect, technological nonhuman actors, police officers, mapping and political institutions. In referring to “algorithmic” here and throughout the paper, I wish to refer broadly to the use of software to analyse data and produce a definitive output through a set of rules, i.e. an algorithm. In this software analysis, there is a reliance on a nonhuman agent (the software itself) as a key link in decision-making. My use of the term “technological nonhuman” in this paper is intended to identify nonhuman actants (following Actor-Network Theory and Feminist New Materialist discourse) that result from human technological intervention, i.e. microphones, software, even cables connecting microphone arrays to networks and servers. In this distinction, I aim to understand the effects of the materialities of this system. Further, the materialities and temporalities of the system trouble and expand the theorizations of vision and mastery often read into surveillance systems and modes of sensing beyond the visual (Haraway 1988; Kittler 2010; Virilio 2002). Taken together, these imbrications force us to incorporate broader theorizations from *assemblage* thinking, pushing us beyond Kevin Haggerty and Richard Ericson’s (2000) notable *surveillant assemblages*. In analyzing ShotSpotter Flex’s design and deployment in this way, I identify not only the existing political terrains of the system, but also identify contours of emergent and possible future landscapes at this particular nexus of technology, territory, policing and affect. This work approaches this task by examining, first, the case of DeOnté Rawlings, a black, 14-year old child who was shot and killed by an off-duty police officer in Washington, D.C. The ShotSpotter Incident Report of the shooting, despite some serious ambiguities, became a key piece of evidence in exonerating the police officer. In so doing, it reveals the way that the materialities of a system like ShotSpotter Flex, become allied to state power, institutional racism, and open a view to the enactment of technologies of territory and legibility on the urban scale. Moving from the Rawlings case, this work then examines the way ShotSpotter Flex engages, mobilizes and adapts particular ideologies and logics of mastery regularly associated with the visual. In examining the effects of introducing surveillance technologies to the area of sound, this work examines the political and affective implications of opening up the question of sound within Surveillance Studies.

In taking on this project, the hope is not only to explore the political implications of ShotSpotter Flex as a surveillance system or its relationships to theories of sensing and power, but also as a means to engage Surveillance Studies with the materialities and nonhuman agents that underpin surveillance as a phenomenon and technology. As well, this work seeks to engage the ways acoustical surveillance is mobilized in the service of structural racism and the racial management of space.

Violence, Impunity and the Production of Evidence: DeOnté Rawlings

Officer James Haskell shot DeOnté Rawlings on September 17, 2007 in an alley of a public housing project in Southeast Washington, D.C. According to the *Washington Post* (Thompson 2009), Haskell had been looking for his stolen mini-bike with another off-duty officer when the two reportedly saw Rawlings heading down an alley on the mini-bike. Haskell reports shouting at Rawlings to leave the bike, but the two never identified themselves as police officers. The off-duty officer accompanying Haskell reported he saw Rawlings draw something from his pocket and told Haskell that he thought Rawlings had a gun. Haskell recounted to the police that he also thought he saw Rawlings draw a gun and then fire at the car. Haskell claims to have fired two shots before Rawlings began to run. Haskell then reports he stepped out of the car and fired six more shots while Rawlings returned fire over his shoulder. During this exchange, Rawlings was shot in the back of the head. Haskell then radioed for assistance, noting there was, “an officer involved shooting” and a “suspect down” (Thompson 2009). Haskell reports that he did not approach Rawlings to check on his condition. Haskell told the other off-duty officer with him to drive his car away and then called for a police cruiser due to a “hostile crowd.” Haskell fled, leaving the scene and flagging down a cruiser. Rawlings died at the Children’s National Medical Center two and a half hours later.¹

However as further evidence emerged, Haskell’s narrative began to cloud. Rawlings’s autopsy states that “The hands and fingers have no visible blood nor any obvious gunshot residue, powder or soot” (Williams, M.D. 2007: 3).² Beyond this, Thompson (2009) outlined numerous other irregularities with the handling of evidence and witnesses by Haskell, his companion, and the Metropolitan Police Department (MPD). An analysis of ShotSpotter Flex data from the incident, authored by two analysts from SST, Inc. took up a key position in the MPD’s investigation. This ShotSpotter Incident Report³ was highlighted by the MPD in its exoneration of Haskell. In taking up the ShotSpotter Incident Report specifically, I do not wish to try to discern Haskell’s guilt or innocence but to interrogate the way the report itself gets deployed, circulated and mobilized within the existing logics and structures of power that underpin structural racism. In this section, the Rawlings case stands as a means to explore the way acoustic and data ambiguities present in the incident report itself, become eclipsed by the objectivity of the nonhuman agents of the ShotSpotter Flex system.

The report has not only been used by the MPD as a foundational piece of evidence in clearing Haskell of any wrongdoing, as mentioned above, but was itself generated by a lack of clarity on the part of the algorithmic, sensory and representational output from the ShotSpotter system. Obtained by the *Washington Post* in the aftermath of the Rawlings shooting, the ShotSpotter Incident Report purports to offer an interpretation of the findings that identifies, if not clarifies, the ambiguities in data collected by the ShotSpotter system. By reading the report’s content and comparing it to other physical evidence produced, I hope to identify the tension that emerges between ideologies and aspirations of certainty and the lived uncertainty of the incident. Further, I hope to highlight the way the report’s content stands in contrast to the ways in which it was mobilized by the MPD and how this allows us to understand the political effects of surveillance technologies beyond questions of policy or privacy.

The ShotSpotter Incident Report of the DeOnté Rawlings shooting opens with a caveat, “Because of the complexity of the audio, it is not possible to unambiguously determine the number of shots fired or the exact location and timing of those shots on the basis of audio evidence alone” (Calhoun and Foster 2007: 1). The report goes on to specify that “audio fingerprinting” needed to be employed to distinguish between the two shooters involved in the incident (Shooter A and Shooter B, in the report). It also specifies that

¹ All of the above comes from Cheryl Thompson’s (2009) reporting of Haskell’s account of events in the *Washington Post*.

² Autopsy Report was garnered from its publication by the *Washington Post* (2009).

³ ShotSpotter Incident report was also garnered from its publication by the *Washington Post* (2009).

“echo fingerprinting” of these shots needed to be used to identify the shooters. The report’s authors identify the way that this “audio fingerprinting” and “echo fingerprinting” involved greater scrutiny of the signals from certain sensors and the amplification of particular frequencies to identify shooters. In this, we see an attempt to recuperate the credibility of the report’s findings in the wake of the sensors’ and software’s inability to produce a definitive answer. However, we also see the subjective human decision-making and agency nested inside the claims to “mechanical objectivity” (Daston and Galison 2010). The report even concedes in this section, “It may be that [shot] “A2” is an artifact or echo of B2 rather than a real shot” (Calhoun and Foster 2007: 6). In this vein, the report also points to further obfuscation of location and number of shots fired by the architectural features of the shooting site stating, “Different sensors report different audio because of the complex way in which sound propagates in an urban environment” (2007: 6). Beyond these ambiguities the report identifies one shooter as firing “3 or possibly 4 shots” and the other shooter (presumably Haskell) as firing eight shots (2007: 10). I pick up on the ambiguities in discerning the number of shots fired and the need to use “acoustical fingerprinting” as it points to the process that goes into the production of ShotSpotter data points and their limits. In the report, the “acoustical fingerprinting” relies on the identification of the unique waveforms (themselves a translation of the atmospheric intensities that produce sound) measured by the ShotSpotter Flex microphones in order to discern the two different firearms. This process is one of producing limited certainties and fixed quantities out of measurements that are questions of intensities. Further, when these data points get mobilized in the defense of Haskell, we see these data points migrate in tension with the narrative of certainty and mastery extolled in the state’s narrative of the shooting and the marketing materials from SST, Inc. In its promotional materials, SST, Inc. declares that ShotSpotter Flex offers “Constant, 360-degree, wide-area acoustic surveillance” (SST, Inc. 2014: 2).

There are numerous questions raised by the handling of the case from Haskell and the Metropolitan Police Department, however the ShotSpotter Incident Report offers us a tangible example of how the appeal to an objective, surveillant perspective risks eliding important questions regarding structural racism and use of force by law enforcement in the United States. This appeal to nonhuman agency as a means of exonerating Haskell turns on a notion of objectivity that propagates in both the abstract notion of the data point (as we see above, its own kind of motivating nonhuman agency), and the nonhuman agency of the microphone. In doing so we see how the objectivity of measurement gets mobilized into the broader objectivity of rendering the space intelligible, a kind of translation of the acoustical by the logics of mastery typically deployed in the visual (as will be explored further in the following section). Further, the physical location of the estimated gunshots from the ShotSpotter Incident Report conflicts with where the evidence report locates the cartridge casings from the other gun in the incident (Pagan 2007; *Washington Post* 2009).⁴ The evidence report places the cartridge casings much further away than where Haskell claims the shots at him originated. Further, Thompson (2009) has reported that these casings were later found to be too old to have been from the Rawlings shooting.

In viewing the ShotSpotter Incident Report in the context of the evidence and autopsy reports, the political and ethical landscape begins to emerge. To this end, I want to draw attention to the way the ambiguities in the ShotSpotter Incident Report from the DeOnté Rawlings case fits into a process of spatialization regarding the alley where Rawlings was shot and how this is marshaled in a broader context that further entrenches the devaluing of black and other racialized lives within American policing. The indeterminacy of the ShotSpotter report in the DeOnté Rawlings case serves to undermine the imaginary that is produced by the system’s implementation, the aspiration to “real-time” knowledge and “pin-point” locations. More, it represents the limits of ShotSpotter’s perspective. By extension, it represents the edge of space that is intelligible to the perceptions of the state. As mentioned above, the report itself declares that the architectural features of the alley render the ShotSpotter Flex data unclear. The shot locations are murky

⁴ The evidence report, as of this writing, is hosted by the *Washington Post* (2009) and the URL is included on the reference list. The discrepancy in distance was raised in the *Washington Post*’s evidence summary cited here.

due to the echoing in the alley leading only to probable and possible shot locations. In that alley, ShotSpotter runs up against its limits and by extension the perception of state power also runs up against its limit. With this in mind, we could understand the emergence of a breakdown for the state in the intelligibility of the alley where DeOnté Rawlings was shot. This is a breakdown both at the edges of the surveillant perspective and discursively in the contestations that are produced from the incident. Further, in this, we can see what Rachel Hall (2015) has identified as the construction of safety and threat through the qualities of transparency and opacity. Hall identifies the ways that airport body scanners produce a purportedly neutral, transparent body but in turn also produce the threatening opaque bodies of others. Similarly, Simone Browne (2015) identifies the deep history of constructing blackness as duplicitous and by extension threatening and opaque in runaway slave notices. Browne also connects the practice of branding and techniques of tracking and tracing slaves to contemporary biometric surveillance. In both of these, we see the aligning of the limit of a security apparatus's means of perception and the production of threat. In this, we see these biometric technologies, much like ShotSpotter Flex, purporting to produce perfect, objective perception, but instead eliding and, as Browne notes, producing racialized subjects. I bring this up in the context of the Rawlings case to identify the way that purportedly neutral technologies, technologies meant to remove human bias, emerge as critical components and allies to racist, sexist and ableist processes. While bodies may not be at the center of ShotSpotter Flex, as we see with the killing of DeOnté Rawlings, they are certainly implicated. The logics of power that underpin "neutral" technologies like body scanners, biometric identification or acoustic gunshot detection are not neutral in the context of structural racism, sexism and ableism. As well, the history of police surveillance in America more broadly can be tied directly to the institution of slavery and its continuing effects (Browne 2015).

When the MPD cites the report as exonerating evidence, it forecloses any contestations of the events and re-asserts the intelligibility of the alley. In so doing, however, it also extends a deeper phenomenon: the foreclosing of contestations within the legal fiction of the event. The family has argued that the evidentiary gaps in the case actually point to a different person having the mini-bike and shooting at Haskell (Thompson 2009). Moreso, other contestations of the state's narrative include memorials erected in DeOnté Rawlings's memory, the family filing a civil suit and extensive investigative reporting by Cheryl Thompson at the *Washington Post*. DeOnté Rawlings continues to be a figure in protests against police brutality in Washington, D.C. to this day (Cohen 2015). The civil suit notably resulted in a settlement in favor of Rawlings's family. Though, this settlement does not necessarily represent the justice sought by the family. Charles Rawlings, DeOnté's father, has been quoted as saying the family accepted the settlement rather than going to court because they were "tired," and because "I can't keep carrying that burden on my shoulders." (Thompson 2011). Further, in 2012, as part of a roundtable discussion in the wake of the Trayvon Martin murder, he has declared that he still does not feel justice is served because the officers were exonerated in the face of evidence suggesting their guilt, or at least their negligence. He stated of the incident, "No gun, no stolen bike, no, nothing on his clothes...no justice" (Roberts 2012).

In mobilizing the ambiguous incident report as an object of certitude, the sovereign role of the state re-emerges in this scale. In exonerating Haskell and asserting the certitude of the report, we see the shooting of Rawlings become a kind of "law-establishing violence," as Walter Benjamin (2009) would articulate it.⁵ The contestation of events and the ambiguity between the MPD's narrative and the Rawlings's family's narrative represents a contestation of not only the intelligibility of the alley to the sovereign gaze of the state, but also entangles the question of legitimate violence within the incident. By exonerating

⁵ Walter Benjamin (2009) situates "law-establishing" and "law-upholding" violence as two components of state violence, or what he dubs "mythic violence." In this, he contrasts it to the "divine violence" of law-expiating, revolutionary violence. These Benjaminian understandings of "law-establishing" and "law-upholding" violence help explain the ways that the MPD's attempts to foreclose narratives in this case result in a situating of the killing of Rawlings into a re-assertion of the continuity of law, a "mythic," "law-establishing," "bloody" violence as the crime of murder becomes recuperated into legitimate violence by the state.

Haskel of wrongdoing and foreclosing the other narratives of the event, the MPD, and by extension the government of the District of Columbia, incorporates Haskel's killing of Rawlings into a regime of legitimate violence. In so doing, DeOnté Rawlings, and young, black men and women in the area more broadly, are placed into the sphere of what Benjamin articulated as *bare life*, a condition of exposure to the physical violence of the state, an exposure to pure, bloody "law-establishing" violence. This understanding of *bare life* offers some key resonances with Alexander Weheliye's (2014) critiques of Giorgio Agamben's expansion of Benjamin's concept. Weheliye notes that enslavement offers a fundamentally different expression of *bare life* than Agamben's archetypal camp. This has been similarly noted before by Sibylle Fischer (2007). Weheliye argues against the disembodiment nature of Agamben's claims around *bare life* by invoking Hortense Spillers's notion of "flesh." Weheliye states "If the body represents legal personhood qua self-possession, then the flesh designates those dimensions of human life cleaved by the working together of depravation and deprivation" (2014: 39). In this, we see a more relevant expansion and elucidation of Benjamin's *bare life* than Agamben's. One that re-asserts the "bloody," embodied nature of violence to *bare life*. Weheliye's approach highlights the way *bare life* operates as a relation between individuals and legal fictions and as a site of contestation itself.

Taking this concept to our present case, we can see how the mobilization of an aspiration to technological certainty over countervailing, if not at least troubling, evidence serves to constitute a system in which DeOnté Rawlings and other young men and women like him are rendered subject to the pure violence of the state. The uncertainty of whether Rawlings had ever fired at Haskel is collapsed, a space where guilt and punishment become collective. In this, *bare life* operates not as a static category but as a means to speak in the context of a legal fiction, which attempts to foreclose contestations of sovereignty. Here, the categorization of *bare life* sits at the intersection of the lived world and narratives of state power. Robin D.G. Kelley (2016) has situated this process as part of a historical and institutional devaluing of black and brown bodies by police. Kelley articulates that "black and brown bodies carry from birth the mark of suspicion" in American society (2016: 17). The exoneration of Haskel despite the ambiguities in the evidence, the attempts to foreclose contestation of this narrative and Rawlings's guilt fit into what Kelley has outlined as a broad reaching assumption in American criminal justice culture that these black and brown bodies are guilty of something, even if not the crimes of which they are accused. Keeanga-Yamahatta Taylor has described this as condition as "the space between freedom and 'unfreedom' where the contested citizenship of African-Americans is held" (2016: 108). In the context of the ShotSpotter Incident Report and the exoneration of James Haskel, we can see how the report, and even ShotSpotter Flex itself, becomes part of these systems of criminalization and oppression for black people in America.

This is important to remember as we look to the contemporary moment wherein surveillance of the police through body cameras has been offered as a solution to the recent spate of high publicity police killings of black men, women and children in the United States (i.e. the deaths of Michael Brown, Eric Garner, Sandra Bland, Rekia Boyd, Korryn Gaines, Tamir Rice, Philando Castile, and more). However, the examination of the use of the decidedly inconclusive ShotSpotter Incident Report echoes a caution issued from a working paper published by Alexandra Mateescu, Alex Rosenblatt and danah boyd (2015). The paper, which addresses the contemporary enthusiasm from both civil rights groups and police departments for police-worn body cameras, cautions against a reliance on body camera footage as "objective" evidence. They caution that not only can video have social and historical biases against racialized people read into it, but it also erases the contextual information that falls outside of the camera's lens or precedes the start of recording. As well, Browne (2015) has picked up this same theme more holistically in her situating of surveillance within Butler's "racially saturated field of visibility" (2015: 20-21). The parallels to the use of the ShotSpotter Incident Report in the case of DeOnté Rawlings appear clearly. In these, we can see how the perceived objectivity of the technological nonhuman (i.e. microphone and camera) is mobilized to foreclose contestations of events and solidify and naturalize racist structures.

Yet, despite these ambiguities and limits, the case also demonstrates the power of ShotSpotter Flex's aspirational allure to "pin-point" accuracy and blanket perception in its mobilization to the exoneration of Haskell. The result of this dialectical tension between the aspiration to what Haraway (1988) has dubbed the "god trick" of total, objective perception and the murkiness of the lived world is the marshaling of the objectivity of a technological nonhuman actor, the microphone, the algorithm, in the service of supporting productions of racialized bodies as precarious and expendable. We can think of this kind of mechanism in similar terms to how Louise Amoore (2013) has described the birth of "possibilistic" decision-making, "When data on past events are incomplete or absent, probabilistic knowledge is loosened to incorporate assumptions about that which is merely possible" (2013: 30). Amoore is speaking broadly to the uptake of the wartime accounting practices of Price Waterhouse as a technique of governance in the United Kingdom, but there is a powerful analogy to the way the ShotSpotter Incident Report was mobilized in the DeOnté Rawlings case. The excavation and circulation of the mode of knowing employed by Price Waterhouse has huge political, ethical and epistemological impact when it is circulated beyond the circumstances of its original production. In the Rawlings case, the ambiguity of the ShotSpotter report required this kind of "loosening" of probabilistic knowledge in the interest of possibilistic assumptions of Rawlings's guilt.

With this understanding of the Rawlings case, we are left with the question of how we might understand the particularities of this new frontier of surveillance, not only as it pertains to its acoustical and nonhuman materialities, but the way in which these interact with the diagrams and logics of state and police power.

Surveillance, Vision and the Acoustical

The case of DeOnté Rawlings demonstrates not only the stakes of acoustical surveillance technologies like ShotSpotter Flex, but also its undertheorization. The literal and metaphorical adoption of vision as a metonym for intelligibility results in a well-documented eliding of the particularities of sensing beyond the visual. Hillie Koskela has claimed that in surveillance, the visual "*overpowers* other senses" (2003: 297). Beneath these visual epistemologies and techniques dwell the more telling diagrams of objectivity and mastery that animate them. Further, the growing reliance on nonhuman action and algorithmic filtering only further obfuscates these diagrams in metaphor. Any process of machine sensing is always already a metaphor. For example, what has been called "machine vision," crucial to any number of contemporary technologies, only operates by analogy of human vision. Similarly, systems like ShotSpotter Flex that operate primarily in the acoustical urge us to refocus our understanding of sensing beyond the human. This is why in this work I have and will consistently refer to the acoustical, rather than the aural, so as to emphasize the independence of ShotSpotter Flex's perception from the human sensorium. Stephen Goodman (2010) has called for an "ontology of vibrational force" when we approach sound. Goodman defines this as an understanding that "delves below a philosophy of sound and the physics of acoustics toward the basic processes of entities affecting other entities. Sound is merely a thin slice, the vibrations audible to humans or animals" (2010: 81). By using the term "acoustic," rather than the "aural," I am attempting to re-assert the materiality of sound, and decenter the centrality of human perception in these phenomena.

The obvious starting point for this discussion is Michel Foucault's deployment of Bentham's Panopticon. Foucault's (1995) analysis, at least superficially, seems to rely on the particularly visual nature of Bentham's design (i.e. the quality of uncertainty of being under the vision of the jailer). However, as Kevin Haggerty (2006) and David Murakami Wood (2003) have pointed out, this reading of Foucault's work and a reliance on this reading within Surveillance Studies is a hindrance to better understanding the social and political mechanisms of surveillance. To this end, I wish to offer an alternative. Rather than understanding the panopticon as being primarily a technique of vision for Foucault, I show how a reading

of Foucault's panopticon that privileges vision obscures the ways power flows through, and the mechanism of, this surveillance within the disciplinary society that Foucault is attempting to address.

By focusing on vision in Foucault's theorization of the panopticon, we elide the social and political functions of surveillance. This prevents us from a deeper engagement with the social, cultural, and spatial mechanics of surveillance. Kevin Haggerty (2006) and Majid Yar (2003) have criticized the use of the panopticon in Surveillance Studies for similar reasons I outline here. However, unlike Haggerty's or Yar's critiques, I do not read the problem as a flaw in Foucauldian theory, but an overemphasis on vision in the reading of the panopticon. Following Stuart Elden's (2003) argument regarding the role of the panopticon in Foucault's work, I maintain that it is not constitutive of disciplinary power, but an exemplary expression of it and its logic, a metaphor for the internalization of the corrective attention of the state (2003: 246-247). Importantly, Browne (2015) has identified the slave ship as the precursor to Bentham's conception of the panopticon. This identifies a need to conceive of the technologies of surveillance in the management and control of racialized bodies. As Browne points out, where the panopticon was purely theoretical, the slave ship was implemented, integral and lived. In this, Browne identifies the necessity of remembering the primary role of the management and disciplining of black bodies in the development of surveillance. This, in turn, lays the groundwork for the critique to follow. At the core of the argument is an understanding taken from Browne's work that surveillance is not an end in itself, but a means to various ends. It is with this that we can attempt to understand how the primacy of vision in readings of Foucault has obscured more specific understandings of the flows of power through surveillant assemblages.

In the present endeavor, this over-reliance on the visibility of panoptics prevents us from drawing connections between critiques of how vision becomes a technique of mastery developed in the 20th century and the relationship between these techniques of mastery and acoustical sensing. To draw these connections, we must begin to think of how the formulations of Donna Haraway (1988), Paul Virilio (2002) and Friedrich Kittler (2010), among others, on the intersections of power and vision, become expressions of a desire towards mastery, a desire towards, what Gilles Deleuze and Felix Guattari (2008) have called, "striation." A desire that gets channeled and shaped by the material availabilities and possibilities of vision, but not a desire *founded* on vision, much like Foucault's panopticon is the expression of a disciplinary logic, not its foundation. Browne (2015) has identified a range of technologies, and techniques of circumventing them, developed for the management and control of the body itself. Many of them predicated on techniques of vision (but certainly not exclusively), from Lantern Laws to branding and physical descriptions of runaway slaves, Browne traces a relationship often predicated on vision, but again, we can see it as a means not an end. Stepping off from this, we can trace how the logics of vision and their entanglement with logics of mastery outlined above have been adopted, transformed or discarded in the implementation of ShotSpotter Flex's use of acoustical surveillance and the technological non-human surveillant.

While we can trace the certainty of vision through the development of optical media as highlighted by Friedrich Kittler (2010), the acoustical is the realm of contingency of the unitary and the particular. The ShotSpotter assemblage (microphone to algorithm to map, etc.)⁶ is designed to work in a variety of urban landscapes, and to discern the probable "gun shot" from fireworks or dumpsters closing and cars backfiring. Even its locative features are a function of probability, as we have seen in the report from the DeOnté Rawlings shooting. However, importantly, as reported by the *Washington Post*, fireworks *do* present a problem for the system, as do gunshots fired at point blank range, fired with silencers and fired

⁶ The assemblage certainly stretches further as it engages crime statistics through its datapoints, courtrooms through incident reports, policy, law and points further. These further points extend far beyond the audible into the unconscious of anti-black racism into which these points are imbricated, as seen here in the DeOnté Rawlings case. This follows Browne's (2015) discussion of the way the surveillance of blackness operates in spaces constructed for whiteness (2015: 20).

from within cars (Petho et. al. 2013). These ambiguities and uncertainties become tragically demonstrated in the case of DeOnté Rawlings. Further, the very nature of ShotSpotter's function, determining the acoustical signature of gunshots, is based on the measurement and identification of particular acoustical intensities of pressure. Michael Hardt expands upon Deleuze's concept of the society of control to characterize this control as being marked by "a play of degrees and intensities" (1998: 141). In ShotSpotter Flex, we see this not only in the metaphor and logic of probability and estimation underpinning it, but in the very materiality of its mechanics.

As mentioned above, Amoore (2013) has dubbed this particular nexus of power and epistemology, "the politics of possibility." She sees this as an outgrowth of both the rise of accounting logics as a technology of governance in wartime Britain and the reliance on algorithmic logics as a mode of projecting the actuarial logic of risk forward into the management of future threat. Brian Massumi (2010) has dubbed the role of affect in this logic as, "the future birth of the affective fact," particularly in discussing the nature of threat and terrorism. For Massumi, it is the futurity of a threat that results in its immediate affective enactment (2010: 54). This view overlaps with Amoore's (2013) own articulation of the politics of possibility as an attempt to manage anticipatory risk, not only the outcomes that are probable, but all those that are possible. Amoore offers of temporality in the politics of possibility, "The significance of the temporal register of risk lies not in a speeding up but in an algorithmic 'framing of time and space' that has a distinctive orientation to the unknown future" (2013: 61-62). We can see this difference in ShotSpotter Flex's own use of its "real-time" information and "proactive analysis" as exemplary of this kind of future oriented logic (SST, Inc. 2014: 1-2). Deleuze cites this kind of open-ended logic as the marked difference between the modulation of the logic of control versus the clear demarcations of disciplinary enclosure, seen in Foucault's panopticon (1992: 4). In regards to the case of DeOnté Rawlings, we can see how these logics of control and possibility support the use of the ShotSpotter Incident report in the foreclosure of contestations. It also speaks to understanding the space of the alley where Rawlings was shot, as a space where threat, guilt and criminalization are forgone conclusions.

The Certainty of Vision and its Heavy Legacy

Donna Haraway describes the relationship of objective knowledge and mastery as "the god trick of seeing everything from nowhere" (1988: 581). Haraway situates this description within a broader discussion of the epistemological underpinnings of a masculinist, technoscientific perspective of objectivity and perfect vision. Here, we can look back to Foucault's deployment of the panopticon as a symptom of a disciplinary logic of power, rather than its full expression. Similarly for Haraway (1988), the visual "god trick" becomes an expression of the broader work of patriarchy and capitalism: a pseudo-objectivity unmoored from its situated position. We can see more connections to Haraway's analysis when we consider Friedrich Kittler's (2010) identifying of the first uses of television in Germany to be the transmission of identifying details of criminals and the early uses of photography among Parisian police to document those arrested (2010: 211, 141-142). In these cases, we see not only the attempt towards Haraway's notion of mastery in extending the reach of police by transmitting evidence across territory, but also the production of foreclosed identities in the analog data trail of the photograph of the criminal and a fingerprint. Further, it is not hard to connect these affinities in the epistemology of objective vision for mastery and the desire of disciplinary logic to make "ordered multiplicities" of populations (Foucault 1995: 148).

These identifications of epistemological relationships between vision and the logic of enclosure are important for understanding the object of state power in, as Haggerty and Ericson (2000) have dubbed it, a *surveillant assemblage*. However, we can look to Paul Virilio's writings on vision and targeting to understand how these logics not only exceed vision, but also how they are affected by the birth of anticipatory and actuarial logics. Virilio argues of vision and military targeting that:

the importance of the rapid discrimination of targets is really no longer a matter of distinguishing between ‘true’ [vrai] and ‘false’ carriers of arms..., but between a genuine or false radar signature, a plausible [vraisemblable] or implausible acoustic, thermal or electrico-optical image. (2002: 126)

In this, Virilio points to how technologies of targeting transition from certainty (enclosure, “ordered multiplicities”) to “plausibility” which exists entirely in the realm of the contingent, of the possible. These various modes of rendering a space intelligible remain underpinned by an aspiration to mastery and certainty, even if the parameters that constitute certainty may be shifting. Caren Kaplan identifies the understanding of representation that underpins this as “a question of the division and distribution of the perceptible, making impossible some possible ways of being and knowing” (2013: 75). In this, we understand not only a question of the intelligible and unintelligible, but the erasure of that which is at present unintelligible or unable to be made intelligible. Returning to the Rawlings case, we see this in the state’s foreclosure of contested narratives of what transpired in the alley. In privileging systems like ShotSpotter Flex, we see the erasure of contravening evidence and histories.

In taking Virilio, Haraway and Kittler forward, we can see the way that David Lyon’s (2002) identification of the contemporary role of surveillance as “social sorting” and the way these surveillance systems fit with the move to what he calls “actuarial justice” are imbricated with broader epistemological shifts identified by Deleuze, Foucault and Amoore. With these in mind, we can begin to compare the logics and materialities of ShotSpotter Flex with the most common urban surveillance system, Closed Circuit Television (CCTV). In so doing, we can understand in a more concrete way the migration and adaptation of these logics from the perspectival vision of the camera to the ambience of the microphone.

CCTV, the City, and Space

While much has been written about CCTV, I wish here to focus primarily on the role of CCTV in the ideological construction of spaces and as an instrument of state power. Further, I wish to engage how the materialities of CCTV and ShotSpotter Flex, as visual and acoustic technologies respectively, constitute a striation of urban space in different ways. Lastly, I wish to approach the way that SST, Inc., the company that makes ShotSpotter Flex, encourages the incorporation of ShotSpotter Flex into existing surveillance systems as a means to discuss the underpinning epistemologies and logics that can be made apparent by expanding our view of surveillance beyond primarily visual or data perspectives.

In his article on the deployment of CCTV cameras in Liverpool and its connection to neoliberal techniques of governance, Roy Coleman (2004) articulates the importance of considering the infrastructure of widespread CCTV use and the role of the affective quality of safety (often entwined with the concept of “quality of life”) in shaping and policing the neoliberal urban. This points to the broader import of surveillance technologies in the processes of state power, and importantly, their role in constituting urban space and imaginaries. Coleman explains, “Camera surveillance merges ‘crime control’ that seeks to manage a notion of ‘quality of life’ that in turn reflects the re-imaging of place” (2004: 298). Coleman goes on to discuss the ways that CCTV is used to highlight and focus on particular populations and types of crime, as well as particular areas, like the Liverpool city center. Broadly, he offers, “As a key tool in the politics of vision, cameras in the cities of the UK are helping to put into effect what can and cannot be seen on the streets” (2004: 301). This highlights the key mechanic I wish to draw from Coleman’s analysis of CCTV. CCTV offers a specific way of knowing a space, in which the material limitations of CCTV technology reflect back on and intersect with particular productions of space, citizenship and subjectivity. To this end, Koskela (2003) has previously argued that in the current era of proliferating CCTV systems and cameras more broadly that surveillance aims to “normalise” urban space (2003: 300). In line with Coleman’s explanation of the way CCTV acts as a conduit of state power, I want to point to Keith Woodward and Mario Bruzzone’s (2015) recent work, which articulates the way that the

vision of the state acts as a mode of “touching” by the state. In so doing, we can begin to perceive the CCTV camera as a technological nonhuman intermediary for state power, a kind of “touching without touching” (2015: 3). This reference to “touching without touching” is not so much to equivocate between modes of sensory perception, but instead as an invitation to think about affect and state power, the mediums and relations through which state power is exercised. Further, as a means of knowing space, we must return to thinking of CCTV as a technology of mastery, rather than vision. Coleman’s assessment of the role of the CCTV camera’s vision and the prosecution of certain crimes over others is telling in this regard. Coleman points out, “through the eye of a street camera a host of urban social problems; including popular protest, homelessness, street trading and petty violations of local byelaws become detached from any social context, and instead defined through *crime* and *disorder*” (2004: 300).

Coleman’s example of CCTV in Liverpool and its mobilization of the quality of visibility prompts us to ask how the state might render attention and affect through the material, sensory field of ShotSpotter Flex and its implementation. As mentioned above, ShotSpotter’s reliance on the acoustic register demonstrates to us a different mode of constituting space than the linearity of vision. Instead, its reliance on sound, the compression of air molecules, renders the ambient atmosphere and architecture of the surveilled space an active part of its field of perception. Here, the role of sound in ShotSpotter Flex can change how we think of sound within surveillance, unique in ways from SONAR or eavesdropping and signals intelligence. Sound in ShotSpotter Flex renders the very atmosphere a surveillant medium. To better focus our understanding on this, we should return Goodman’s (2010) concept of an “ontology of vibrational force.” This conceptualization becomes particularly important when we think about ShotSpotter Flex’s mobilization of acoustics as a material mediation between two nonhuman actors (i.e. guns and microphones). Rather than Coleman’s scale of visibility, ShotSpotter Flex poses us questions of detectability. This detectability extends beyond the human sensory capacity and relies on the very spatial characteristics of the scene (i.e. range of the gunshot, whether it is fired from within a car, etc.). Together, these facets lead us to conceive of what can only be described as an ambience of surveillance.

This notion of an ambient surveillance also returns us to the questions of intensity, raised in the previous discussion of Deleuze’s (1992) societies of discipline and control. As opposed to the ascribed certainty of the vision of the camera, we have a constant detection of modulations in the intensity of ambient vibrations and a discernment, looking back to Virilio. Rather than a judgment between true and false, as Virilio (2002) points to, we see a plausibility of vibrations, an evaluation, as to the source and location of the gunshot vibrations. Further, wherein the CCTV camera is looking at the present (with an operator) or past (recording), we see in ShotSpotter, the present and past (real-time mapping and incident report) and the future (the gunshot records as models for future oriented prevention). This evaluation, embedded in these temporalities, is where we see the broader social factors embedded in and produced by surveillance systems (as highlighted by Coleman and the Rawlings case) re-emerge. Amoore (2013) has identified the rise of the evaluation as underpinning both algorithmic logic and the extrapolated logic of the “possible.” The ambiguity that resides in these paradigms (as well as ShotSpotter Flex reports themselves) stand in stark contrast to the prescriptive certainty of the CCTV camera’s vision. However, while CCTV cameras have clear gaps and ambiguities in their perception as well, ShotSpotter Flex, and acoustical surveillance more broadly, is predicated on ambiguity. That is, the system operates by identifying bracketed thresholds of intensities and producing data points from this.

The Persistence of Mastery

We can see in its reliance on acoustics and technological nonhuman actors how ShotSpotter Flex is both an example and producer of the logics of control and anticipatory risk identified by Deleuze (1992) and Amoore (2013). However, ShotSpotter Flex also demonstrates how, even through its acoustic bearings, the desire of the state for mastery has persisted and possibly even intensified.

In SST, Inc.'s promotional materials for ShotSpotter Flex, as mentioned above, they highlight not only its capacity for "Constant, 360-degree, wide-area acoustic surveillance," but also its possible integration with CCTV and video surveillance systems (SST, Inc. 2014: 2). We can see this clear situating of ShotSpotter Flex into a desire for mastery over a space as indicative of how ShotSpotter Flex, like the concept of the panopticon, functions as an exemplar of a particular logic that extends beyond a particular material manifestation. Instead, ShotSpotter Flex represents the attempt to striate the acoustical register similar to how disciplinary logics of power have mobilized the visual. While this is not limited to ShotSpotter's deployment as an adjunct to CCTV, their proximity helps to illuminate the similarities in the desire and mechanism for striation in both their cases.

Conclusion

In taking up the case of DeOnté Rawlings, I have attempted to show how a system like ShotSpotter Flex becomes quickly incorporated into institutions of state power and mechanisms of structural racism and oppression. The Rawlings case demonstrates the very concrete spatial and ontological stakes of surveillance systems and the need to ensure our research on surveillance looks beyond pure notions of privacy, transparency or policy. Beyond this, I have attempted to demonstrate the ways that a surveillance system like ShotSpotter Flex takes up and transmutes techniques and logics of mastery and domination so often ascribed to the visual. In doing so, I show how these techniques and logics spatialize surveillance through the Deleuzo-Guattarian concept of striation and illustrate contemporary modes of power through Deleuze's notion of modulation. This theoretical frame opens an examination of the undertheorized materialities of acoustical surveillance systems and the ways in which they operate in daily life. Understanding ShotSpotter Flex requires a theoretical framework which accounts for not only the particular materialities of sensing acoustical vibrations, but which also accounts for the imbrications of humans, nonhumans, software, law and policy.

ShotSpotter Flex offers important and provocative intersections with previous streams of research not only in visual, urban surveillance (i.e. CCTV), but also data surveillance and sousveillance more broadly. *Wired* has reported that some communities welcome ShotSpotter Flex as a means to ensure accountability for police response to crime (Watters 2007). However, there is further work to be done about examining exactly where these systems are deployed and how this interacts with contemporary trends in policing and its relationship to structural violences and oppression. As well, there remain unexplored connections to be drawn to similar systems deployed on contemporary battlefields. There are further connections to investigate here between sound, surveillance, and the militarization of American policing. As work by Mark Neocleous (2014) points out, the line between the power at use in war and the power at use by police is murky.

This work also serves as an attempted provocation to the field of Surveillance Studies. ShotSpotter Flex represents the necessity of engaging the materialities and nonhuman agencies of surveillance systems seriously. Further, it asks Surveillance Studies to engage sound with the vigour with which it has taken up visibility. Sound offers us an opportunity to re-examine these connections to material and nonhuman actors, and also pushes us to engage the particular spatial dimensions of surveillance systems from both a spatialization and infrastructural perspective. In doing so, ShotSpotter Flex forces us to think in terms of intensities and modulations. It forces us to consider the very literal materialities and architectures of surveillance that become conduits of power into the very interstices of daily life. This work asks us to look beyond questions of policy or privacy. Instead, it asks that we examine the role of surveillance systems in structural inequalities. It asks us to take the theoretical insights garnered and marshal them to critique racism and other forms of oppression.

The death of DeOnté Rawlings and the use of the ShotSpotter Incident Report as exonerating evidence stands as a sorrowful reminder of the ends to which surveillance data is produced and mobilized.

Oftentimes, surveillance practices remain theoretical footnotes, but as Browne (2015), Hall (2015), Yasmin Jiwani (2015), Shoshana Magnet (2011) and others have demonstrated, these technologies, systems and practices are critical articulations of racist, sexist and ableist security imaginaries. DeOnté Rawlings was a 14-year old child who was killed by a police officer over a mini-bike. While the MPD's use of Shotspotter Flex did not directly lead to his death, it has led to impunity for the officer who shot him.

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