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Public Support for Gunshot Detection Technology

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Abstract

Firearm violence has led many U.S. cities to invest in gunshot detection technology (GDT). Research on GDT remains limited and focuses mainly on whether it impacts police response times, arrests, and injuries. Public opinion about this technology has received limited attention. The current study addresses this gap using surveys in 23 Portland, Oregon neighborhoods with above-average firearm discharges. Respondents were evenly distributed between those opposing GDT and those supporting its use. People with prior knowledge of the technology and those with privacy concerns were more likely to be opposed whereas those who worried about gun violence and those who had greater trust in the local police were more likely to support GDT. The findings highlight the value of assessing community sentiments prior to investing in new surveillance technologies.

Keywords: community attitudes, police surveillance, gun violence, gunshot detection technology, police legitimacy

Public Support for Gunshot Detection Technology

Firearm-related violence is a significant concern in many communities, particularly in the context of rising crime rates and decreasing arrests for serious offenses like homicide (Cook and Mancik, 2023). One of the factors complicating efforts to address these trends is a concurrent decline in citizens' willingness to report crime to the police (Xie et al., 2023). Of particular concern with firearm-related crimes is the fact that most gunshots in urban settings are not reported (Carr and Doleac, 2016; Huebner et al., 2022; Renda and Zhang, 2019). Gunshot detection technology (GDT) seeks to address this by offering the police an independent mechanism for identifying firearm discharges. Consistent with other police surveillance practices, GDT has the potential to generate considerable controversy in cities where it is used or being considered. While GDT opponents seem to garner disproportionate media attention, the few community surveys currently available find that most adults support the use of this technology or think it could be effective in reducing gun violence (Chicago Community Sentiment Survey on Crime and Gunshot Detection, 2022; Haberman et al., 2020; Teale, 2021; Vovak et al., 2021). These surveys have notable methodological limitations including small sample sizes, low response rates, and underrepresentation of key demographic groups. Moreover, none of the studies have undergone independent peer-review and questions have been raised about financial support provided by GDT vendors. Accordingly, there is a need for additional research documenting public sentiments toward this technology. The current project sought to address this gap using a large community survey conducted in Portland Oregon. We start with brief reviews of the research literature addressing GDT and public opinion regarding other police surveillance technologies.

Gunshot Detection Technology

Gunshot detection technology is an umbrella term used in law enforcement to describe electronic devices that are installed in outdoor settings to detect gunshots, identify the location using triangulation across different sensors, and rapidly communicate this information to police dispatchers (Mazerolle et al., 1998; Watkins, et al., 2002). These systems exploit the fact that gunshots have distinct characteristics (e.g., muzzle blasts, supersonic shockwaves, and blast reflections) that can be distinguished from many other sounds, albeit with some limitations related to wind, weather, urban structures, and other factors (Maher, 2007). Studies evaluating GDT using live test firings show a high degree of accuracy in detecting gunshots and pinpointing the location within a small margin of error (Watkins et al., 2002). Questions remain, however, regarding its overall sensitivity and specificity in everyday use, with particular concerns for high false positive alerts that might unnecessarily burden law enforcement (Mares, 2023). That said, further improvements in detection accuracy may be forthcoming with artificial intelligence (e.g., Singh and Zhuang, 2022), and additional benefits may be derived from pairing GDT with other surveillance technologies like CCTV (Ratcliffe et al., 2018).

GDT shows promise as an independent data source for law enforcement because it results in a much larger number of gunshots being documented than would otherwise be reported by citizens alone (Carr and Doleac, 2016; Huebner et al., 2022; Renda and Zhang, 2019). For example, a study in Trenton, NJ found that 25% of gun violence hot spots would have gone undetected in the absence of GDT data (Mazeika, 2022). Similarly, a study in St. Louis observed an 80% increase in gunshot reports after installing GDT, even while factoring in a corresponding 30% reduction in citizen-initiated calls for shootings (Mares and Blackburn, 2021). The latter illustrates an interesting paradox for this technology. On one hand, GDT can help police bridge the gap between the total number of gunshot incidents in a community and the relatively small

percentage that are reported by citizens. This is often a major selling point for GDT vendors. On the other hand, studies suggest that it may further suppress citizen reporting in areas where it is used (Mares and Blackburn, 2012; Mares and Blackburn, 2021). This suppression may extend beyond the immediate coverage area, usually just a small proportion of a city's landscape, because law enforcement administrators often withhold the location of GDT (Lawrence et al., 2018). In some settings, therefore, the addition of GDT could lead to an overall reduction in gunshots identified in a city.

Other studies have explored the impact of GDT on the workload of emergency responders. As noted above, the implementation of GDT can lead to more reports involving a suspected firearm discharge than would be obtained via citizen reporting alone. These additional reports are distributed across four categories. Some are false positives resulting from fireworks, car backfires, and similar noises. Other reports involve an actual firearm discharge but no further criminal intent, such as accidental discharges or when people fire guns in celebration of holidays. Incidents that do involve harmful intent do not always result in hitting the intended target. Finally, some reports involve the injury or death of a victim. The impact of GDT on an agency's call load will depend on the proportion of alerts falling into each of the four categories. Current studies suggest that the latter two categories, attempted and realized assaults, account for the minority of the reports generated by GDT. For example, Ratcliffe and colleagues (2018) found that the number of reported gunshot incidents increased 259% when GDT was tested in Philadelphia but "founded events" based on shell casings, victims, witnesses, or bullet marks remained unchanged. Mares and Blackburn (2012) assessed a trial in St. Louis and found that just 1.9% of reports generated by GDT led to the identification of a violent crime. Their later study (2021) in the same city found that only 0.33% of the 19,473 calls for service generated by

GDT involved a serious violent crime. These results suggest that GDT may substantially increase a police department's workload without leading to the discovery of many otherwise undocumented intentional shootings.

The impact of GDT on police response times has been examined in a handful of studies. In theory, GDT could expedite the arrival of officers because it eliminates the delay between a citizen hearing a gunshot, deciding to call 911, and actually getting through to a dispatcher. Consistent with this, most studies (Choi et al., 2014; Mares and Blackburn, 2012; Mazerolle et al., 1998), but not all (Mares and Blackburn, 2021) find that officers arrive on the scene slightly faster when GDT is used. An earlier arrival by emergency responders may be beneficial for injured parties who receive quicker treatment on-site or expedited transport to a medical setting (e.g., Beattie et al., 2020; Brooke et al., 2017; Goldenberg et al., 2019).

Finally, several studies have examined the impact of GDT on evidence collection, arrests, and crime rates. Lawrence and colleagues (2018) conducted a review of case files and found a marginal improvement in the collection of shell casing evidence following GDT implementation, although this did not translate into significantly higher arrest rates. Mazerolle and colleagues (1998) found that none of the GDT reports they examined led to the apprehension of a suspect. Similarly, Choi and colleagues (2014) reported that GDT had no discernible impact on case outcomes, such as the number of official complaints filed, investigations initiated, or arrests made. Doucette and colleagues (2021) conducted a longitudinal analysis across 68 large metropolitan counties from 1999 to 2016 and found no benefit of GDT implementation on firearm-related homicides or arrest outcomes. Finally, studies by Mares and Blackburn (2012, 2021) did not identify any reductions in serious violent crimes associated with GDT. Collectively

these findings suggest that GDT, as currently used, may yield few benefits with regard to crime reduction.

Public Attitudes Towards Police Surveillance Technologies

Although studies addressing public attitudes toward GDT remain severely limited, there is a growing body of academic literature addressing other police surveillance technologies. This includes closed circuit television (CCTV), facial recognition technology (FRT), unmanned aerial vehicles (UAVs; i.e., drones), automated license plate readers (LPRs), and body-worn cameras (BWCs). Studies addressing these technologies usually find that a large proportion of adults support their use in law enforcement applications. This includes 79% of respondents supporting the use of CCTV on public streets (Gurinskaya, 2020), 77% (average) supporting FRT across seven policing activities (Miethe et al., 2023), 61% supporting the use of UAVs in their neighborhood (Nader et al., 2023), 80% supporting the use of LPRs in the recovery of stolen vehicles (Lum et al., 2018), and 85% supporting the use of BWCs by police officers (Sousa et al., 2018). Most of these studies document the presence of moderating factors that are associated with higher or lower public support for the given technology.

One factor that seems to be strongly associated with support for police surveillance technology is a person's opinion about privacy. Privacy, involving freedom from unwarranted intrusion into one's personal affairs, is considered a basic human right under international law (Humble, 2021). Police surveillance practices that capture sounds, pictures, video, or digital information about people may intrude upon this right. Accordingly, studies find that people who are more concerned about their right to privacy are less willing to support the use of these surveillance technologies in policing. Bradford and colleagues (2020), for example, found that high concern about privacy was the strongest predictor of opposition to the use of FRT by law

enforcement. Similar associations between privacy concerns and opposition to surveillance have been reported for BWCs (Crow et al., 2017; Kopp and Gardiner, 2021; Miethe et al., 2019; Sousa et al., 2015), CCTV (Gurinskaya, 2020), UAVs (Heen et al., 2018; Nader et al., 2023; Sakiyama et al., 2017; Saulnier and Thompson, 2016), LPRs (Merola and Lum, 2014), and other forms of surveillance by the government (Nam, 2019).

Safety concerns are another factor that might impact a person's opinions about police surveillance practices. Gurinskaya (2020) surveyed students in Russia and found that fear of crime, independent of privacy concerns, was positively associated with support for the use of security cameras. Likewise, London residents who worried about crime were significantly more likely to support police use of FRT (Bradford et al., 2020). Similar results were found in U.S. surveys addressing surveillance by UAVs (Heen et al., 2018; Nader et al., 2023).

Several studies have explored the relationships between trust in the police (i.e., the belief that the police have positive intentions), police legitimacy (i.e., willingness to grant the police authority), and support for surveillance technologies. Bradford and colleagues (2020) found that people who had higher trust and granted greater legitimacy to the police were more supportive of using FRT. Likewise, Nader and colleagues (2023) along with Heen and colleagues (2018) found that support for using UAVs was significantly higher when citizens had greater trust in the police. In their study of LPR, Merola and Lum (2014) identified trust in the police as a strong predictor of support for the technology. They went on to hypothesize that trust may be a sort of "social capital" that determines the amount of discretion communities are willing to grant the police when it comes to implementing new surveillance practices.

Finally, several studies have found that support for police surveillance technologies might vary as a function of a person's demographics. Older people were more likely to support the use

of FRT (Bradford et al., 2020) and surveillance of online activity (Cayford et al., 2019), while younger adults were more opposed to drone surveillance (Sakiyama, 2017) and perceived fewer benefits from BWCs (Crow et al., 2017). Merola and Lum (2014) found that older respondents were more likely to approve of LPR technology for parking ticket enforcement, surveilling the movement of people under criminal investigation, and investigating vehicles near important places. This study also identified a connection between race and surveillance technologies, finding that Caucasians were six times more likely to support LPR than other respondents. Similarly, Bradford and colleagues (2020) found that Whites were more accepting of FRT than other groups, while non-White respondents in Florida perceived less benefit from BWCs than White respondents (Crow et al., 2017), a result that was consistent with the findings of a national public opinion research on BWCs (Sousa et al., 2018).

In summary, the existing literature finds that privacy concerns, fear of crime, trust in the police, and certain demographic factors (e.g., age, race) moderate people's support for police surveillance technologies like CCTV, FRT, UAVs, BWCs, and LPRs. It is unclear whether these findings generalize to GDT since several features of this technology distinguish it from these other tools. Gunshots are typically associated with violent crime, whereas a technology like LPR is primarily focused on property crime. As documented earlier, studies have raised doubts about the effectiveness of GDT in reducing violent crime and improving investigative outcomes (Choi, et al., 2014; Doucette, et al., 2021; Mares and Blackburn, 2012, 2020; Mazerolle, et al., 1998). If the public has been exposed to these findings via news outlets and social media it could lead to more negative opinions about GDT. Finally, GDT is largely a reactive policing strategy targeting a singular problem: gunshots. The narrower surveillance role for this tool might lead to fewer concerns about privacy and governmental intrusion. It still seems likely, however, that the factors

influencing opinions about these other surveillance practices will have some applicability to GDT. As such, we hypothesize that support for GDT will be higher when people are more concerned about public safety, when they have greater trust in the police, and when they are less worried privacy violations.

Study Context

The current study was conducted in Portland Oregon. In prior decades Portland benefited from one of the lowest homicide rates among large municipalities (i.e., 250,000+ residents). In 2016, the city had 14 homicides for a rate of 2.2 per 100,000. This compares to a national homicide rate of 11.4 for large cities. Portland's overall violent crime rate was also substantially lower than the national average during this period, making it one of the safest cities in the nation. Unfortunately, there has been a significant deviation in this long-standing pattern during recent years. Portland's violent crime rate increased 53% from 2016 to 2022, compared to a 1% rise among large cities nationally. And while many cities have seen homicides escalate over the past few years, Portland experienced a 571% increase from 2016 with a record 94 murders in 2022. The recent increases in violent offending came at a time when Portland had the fewest sworn officers in more than four decades. Even before COVID-19, the murder of George Floyd, and the city's well-documented protests of 2020, the Portland Police Bureau (PPB) had one of the lowest staffing ratios in the country. During the civil unrest of 2020 and the years that followed, the city lost more than 150 officers to retirement, transfers, and other departures.

The combination of rising homicides, most of which involved the use of a firearm, and diminished police resources spurred considerable debate in 2022 regarding how the city should respond. Much of the discussion centered on the potential benefits or harms of GDT. Some residents and community groups, including an influential police oversight committee comprised

of people living in or working with gun-impacted neighborhoods, strongly advocated for investing in GDT. Other members of the community who regularly attend City Council meetings and community listening sessions were adamantly opposed to using the technology. The Mayor's Office, concerned that they were hearing only the most polarized views on the subject, funded a community survey to collect a broader range of opinions prior to launching a pilot test of GDT. This survey accounts for the data used in the current study.

Research Questions

Six research questions concerning GDT are addressed in the current study. Given the limited research available on this topic, no hypotheses are offered for the first three questions. The hypothesized relationships for the three latter questions are based on research with other police surveillance technologies.

RQ 1 – How many people support the use of GDT?
RQ 2 – Does support for GDT vary across demographic groups?
RQ 3 – Does prior knowledge about GDT impact support for this technology?
RQ 4 – Are people more supportive of GDT when they have fewer concerns about privacy?
RQ 5 – Are people more likely to support GDT when they are concerned about safety?
RQ 6 – Are people who trust their local police more likely to support GDT?

Methods

Sample

The City of Portland had an estimated population of 652,503 residents in 2021 distributed across 94 distinct neighborhoods. Rather than survey all of the neighborhoods, we restricted our focus to the locations where GDT would most likely be used. This involved obtaining four years of data (2019 to 2022) on verified firearm discharges from the PPB. These data were used to identify 23 neighborhoods with an above-average count and rate of shooting incidents. City records were then used to identify the residential addresses in these 23 neighborhoods resulting in a sampling frame of 123,944 locations. Ten thousand addresses were randomly selected and

each address was mailed a letter from the Mayor's Office with an invitation to complete an online survey. The letter, printed in English and Spanish, briefly explained that the city was considering a one-year pilot test of GDT and working with university partners to collect community feedback. GDT was described as a technology that could, "…detect gunshots and then dispatch officers to the location where the gunshots are suspected to have occurred."

People accessed the anonymous online survey via a QR code or short URL provided in the invitation letter. English and Spanish versions of the full survey were available upon entry to the site. The online consent provided additional detail on GDT and the city's proposed pilot test:

> *GDT involves the use of electronic devices to detect and locate outdoor gunfire. The devices are usually installed on telephone poles or other tall objects in high-crime areas of a city. When a suspected firearm discharge is detected, the system alerts the police so they can respond as quickly as possible. The pilot test the City Council is considering would be limited to roughly four square miles across multiple locations. The cost for GDT systems and monitoring can vary significantly but generally range from $70,000 - $85,000 per square mile per year. The Council is interested in hearing from community members prior to making a final decision about investing in GDT.*

A total of 1,033 responses were submitted to the online site during the 7-week study period (10.3% response rate). We removed 111 cases due to substantial missing data (11+ items), 106 cases where the respondent denied living in one of the target neighborhoods, and 10 cases where the respondent did not answer the central question concerning support for GDT. Thus, our final *Random* sample consisted of 806 cases.

To increase our sample size and generate additional feedback for City leaders, we also collected data using a nonprobability or *Open* sample. The Mayor's Office and City Council members distributed invitations to community members via list serves and various social media platforms. A second online site was used to separate the samples, but all of the consent information and survey questions were duplicated from the initial survey. We received 844 responses in the *Open* survey over a 5-week period. This was reduced to 307 final responses

after removing 139 cases with substantial missing data, 395 where the respondent lived outside of the 23 target neighborhoods, and three records missing the key variable assessing support for GDT.

The survey instrument asked respondents to document their demographic characteristics. The first four questions were structured to support direct comparisons with the 2020 Census, either for the city as a whole (sex) or for the 23 target neighborhoods based on extrapolation of Census data (age, race, ethnicity). Females were slightly overrepresented in the *Random* (51.7%) and *Open* (56.1%) samples as compared to the Census (50.2%). Adult residents aged 18 to 34 were underrepresented in both samples compared to the Census (18.7% & 21.0% vs. 33.5% respectively) while people aged 35 to 54 were overrepresented (51.3% & 64.6% vs. 36.7%). Both samples generated smaller proportions when it came to racial minorities (18.2% & 19.0% vs. 44.4%) and Hispanic/Latino ethnicity (7.7% & 7.6% vs. 15.5%). Note that we also queried the respondents about their gender identity. Roughly equal proportions of the *Random* (6.0%) and *Open* (5.9%) survey respondents selected "Transgender", "Non-Binary", or "Prefer to self-describe." In summary, both of our samples underrepresented younger residents and people of color.

Measures

Support for GDT. The survey contained two questions assessing residents' opinions about using GDT in the city. The first item assessed overall support for using GDT: "Based on your current knowledge, do you support or oppose the use of GDT to address gun violence in Portland?" Respondents answered using a 5-point Likert scale ranging from (0) *Strongly oppose* to (4) *Strongly support*. The second question asked, "Would you want GDT used in your neighborhood?" with respondents answering either (0) *No* or (1) *Yes*.

Prior Knowledge of GDT. A single item was used to assess respondents' knowledge about GDT: "How much did you know about GDT prior to this survey?" The response options included (0) *This is my first time hearing about it*, (1) *I knew a little bit about it*, (2) *I knew a fair amount about it*, and (3) *I knew a lot about it*. The latter two options were grouped to simplify bivariate and multiple regression analyses. Participants were also asked to document the different sources they had used to learn about GDT including: *Family, friends, or acquaintances*; *News media (e.g., TV news, newspaper, radio)*; *Research reports (e.g., scientific journals, technical reports)*; *Marketing materials from GDT vendors*; and *Other*.

Privacy Concerns. A 2-item scale was used to assess residents' concerns about GDT and privacy. Participants were asked, "How concerned are you about the use of GDT data for other purposes?" and "How concerned are you about GDT violating people's right to privacy?" These questions were answered using a 4-point scale ranging from (0) *Not concerned* to (3) *Very concerned*. The mean scores for the individual items were 1.83 (SD = 1.24) and 1.63 (SD = 1.30) respectively, producing a mean scale score of 1.73 (SD = 1.20) with a Cronbach's alpha coefficient (α) of .89, suggesting high internal consistency. The resulting measure evidenced a distinct U-shaped distribution with more than one-half (56.3%) of the respondents scoring at either extreme (i.e., 0 or 3). To address this, we recoded the scale score into a final three-level variable: (0) *Not concerned* [M = 0], (1) *Somewhat concerned* [M > 0 and < 3], and (2) *Very concerned* [M = 3].

Gun Violence is a Problem. People might be more likely to support the use of GDT if they perceive that gun violence is a problem in their residential area. Accordingly, the survey asked respondents: "Is gun violence currently a problem in your neighborhood?" The response options included (0) *No* or (1) *Yes*.

Worry About Gun Violence. Concerns about personal involvement in gun violence might impact a person's willingness to support GDT. We used two items to assess this concern: "How often do you worry about being the victim of gun violence in your neighborhood?" and "How often do you worry about someone you know being the victim of gun violence in your neighborhood?" These items were answered using a 5-point frequency scale: (0) *Never,* (1) *Rarely,* (2) *Sometimes*, (3) *Often*, (4) *Very often*. Mean scores for the individual items were 1.48 (SD = 1.03) and 1.67 (SD = 1.12) respectively. A combined scale (Cronbach's $\alpha = .89$) was created by averaging these two questions.

Perceived Safety. A more general assessment of the residents' perceived safety was obtained via two questions: "How safe would you feel walking alone in your neighborhood during the daytime?" and "How safe would you feel walking alone in your neighborhood at night?" Respondents answered using 5-point Likert scale ranging from (0) *Very unsafe* to (4) *Very safe*. Mean scores for the individual items were 3.00 (SD = 1.03) and 2.00 (SD = 1.24) respectively, yielding a combined scale with acceptable internal consistency (Cronbach's $\alpha = .79$).

Trust in the Police. We used three items to assess residents' trust in the local police: "The Portland Police can be trusted to make decisions that are right for my community", "The Portland Police are trustworthy", and "I have confidence in the Portland Police." A 5-point Likert scale was used to answer these questions, ranging from (0) *Strongly disagree* to (4) *Strongly agree*. The mean scores for these items were 1.54 (SD = 1.33), 1.65 (SD = 1.35), and 1.53 (SD = 1.34) respectively. A combined measure was created (Cronbach's $\alpha = .97$) by averaging the three items, producing a mean score of 1.57 (SD = 1.30). The resulting scale deviated significantly from a normal distribution due to roughly one-third of the respondents answering all three

questions with *Strongly disagree*. To address this, we recoded the mean score into a final categorical variable: (0) *Very low trust* [M = 0], (1) *Low to moderate trust* [M > 0 and < 3], and (2) *High trust* [M ≥ 3].

Results

RQ 1 – How many people support the use of GDT?

Opinions about the city using GDT to address gun violence differed significantly across the two samples [χ^2 (4, N = 1,111) = 92.52, $p < .001$]. In the *Random* sample, 46.6% of the respondents supported (20.1%) or strongly supported (26.5%) the use of GDT, 13.9% were neutral, and 39.5% were opposed (8.5%) or strongly opposed (31.0%). In the *Open* sample, 23.4% supported (10.4%) or strongly supported (13.0%) the city using GDT, 5.9% were neutral, and 70.7% opposed (10.1%) or strongly opposed (60.6%).

Our second question asked whether respondents wanted GDT used in their neighborhood. Here again, opinions about GDT varied by the sample [χ^2 (1, N = 1,113) = 63.55, $p < .001$]. Mirroring the findings above, more people from the *Random* sample supported the use of GDT in their neighborhood as compared to the *Open* sample (55.7% vs. 29.0%).

Given the high correlation ($r = .88$, $p < .001$) between our two measures of support for GDT, we opted to restrict all further analyses to the second item that assessed opinions about using this technology in one's neighborhood. We prioritized this metric since it represents a more direct experience with GDT. For the bivariate analyses presented below, we also conducted separate analyses within each sample. The pattern of findings, including directionality and statistical significance, was the same despite the lower level of support for GDT in the *Open* sample (analyses available upon request). Rather than present two nearly identical tables, we

opted to merge the samples. In this *Combined* sample, 48.3% of the respondents answered "yes" to using GDT in their neighborhood and 51.7% said "no."

RQ 2 – Does support for GDT vary across demographic groups?

The next analysis assessed whether support for using GDT in one's neighborhood varied as a function of sex, gender, age, race, or ethnicity. Table 1 provides the descriptive statistics for the *Combined* sample and the results of bivariate associations between these factors and support for using GDT in one's neighborhood. Opinions about GDT did not differ as a function of the respondent's sex, race, or ethnicity. The significant difference observed for gender was driven by low support for GDT (9.2%) among residents identifying as transgender, non-binary, or opting to "self-describe." The other variable that was associated with support for GDT was age. Respondents aged 55 or older were twice as likely to support the use of GDT in their neighborhood (68.1%) as compared to those aged 18 to 34 (34.9%).

The association between these demographic factors and support for using GDT in one's neighborhood was assessed in a multivariate logistic regression model that included all of the other predictor variables discussed below. The sex of the respondent was not used in this analysis due to the high overlap with gender. Separate analyses were conducted again for each sample, but the pattern of findings was largely similar. The only statistical difference was for the variable Worry About Gun Violence. In the *Open* sample, this item did not independently contribute to support for GDT ($p = .10$) while in the *Random* sample, it did ($p = .002$). The odds ratios were nearly identical (1.59 and 1.58 respectively), suggesting that this finding was largely due to varying sample sizes involved (307 vs. 806). Accordingly, we present in Table 2 the multivariate analysis using the *Combined* sample with sample type entered as a control measure. The overall model was statistically significant [χ^2 (16, N = 1,051) = 737.47, $p < .001$], yielding

Table 1. Descriptive Statistics and Bivariate Relationships with Support for Using GDT in One's Neighborhood (N = 1,113[a]).

	Combined Sample	Want GDT Used?		
		No	**Yes**	
Variables	% or M (SD)	% or M (SD)	% or M (SD)	F or χ^2
Sex				.40
Male	47.1%	52.5%	47.5%	
Female	52.9%	50.6%	49.4%	
Gender				42.97***
Male	44.5%	48.1%	51.9%	
Female	49.6%	50.3%	49.7%	
Trans/Non-binary/Other	6.0%	90.8%	9.2%	
Age				63.81***
18 to 34	19.3%	65.1%	34.9%	
35 to 54	55.0%	56.0%	44.0%	
55 or older	25.7%	31.9%	68.1%	
Race				1.89
White-alone	81.6%	52.9%	47.1%	
Minority	18.4%	47.5%	52.5%	
Ethnicity				.99
Non-Hispanic	92.3%	52.1%	47.9%	
Hispanic/Latino	7.7%	46.4%	53.6%	
Prior Knowledge of GDT				229.09***
First time hearing about it	30.7%	27.8%	72.2%	
A little bit	34.3%	42.7%	57.3%	
A fair amount to a lot	35.0%	81.5%	18.5%	
Privacy Concerns				469.00***
Not concerned	20.3%	10.6%	89.4%	
Somewhat concerned	43.7%	36.8%	63.2%	
Very concerned	36.0%	93.0%	7.0%	
Gun Violence is a Problem				33.52***
No	31.9%	64.5%	35.5%	
Yes	68.1%	45.7%	54.3%	
Worry About Gun Violence	1.58 (1.02)	1.25 (.89)	1.93 (1.03)	138.17***
Perceived Safety	2.50 (1.04)	2.84 (.99)	2.13 (.96)	146.55***
Trust in the Police				347.93***
Very low	29.0%	92.2%	7.8%	
Low to moderate	47.9%	43.9%	56.1%	
High	23.1%	17.1%	82.9%	

[a] Sample size varies slightly by comparison due to missing values.
$^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Table 2. Logistic Regression Predicting Support for Using GDT in One's Own Neighborhood.

Variables (reference group)	*B*	S.E.	*p*	Odds
Sample (Open)				
Random	.41	.24	.085	1.50
Gender (Female)				
Male	.19	.20	.346	1.21
Trans/Non-binary/Other	-1.21	.69	.081	.30
Age (55+)				
18 to 34	-.17	.32	.594	.84
35 to 54	-.26	.23	.254	.77
Race (White-alone)				
Minority	.27	.26	.309	1.31
Ethnicity (non-Hispanic)				
Hispanic/Latino	.13	.38	.727	1.14
Prior Knowledge of GDT (1st heard about it)				
A little bit	-.35	.23	.123	.71
A fair amount to a lot	-1.95	.26	<.001	.14
Privacy Concerns (Not concerned)				
Somewhat concerned	-1.28	.28	<.001	.28
Very concerned	-3.62	.35	<.001	.03
Gun Violence is a Problem (No)				
Yes	.25	.23	.273	1.29
Worry About Gun Violence	.47	.13	<.001	1.59
Perceived Safety	-.16	.12	.188	.85
Trust in the Police (Very low)				
Low to moderate	1.30	.30	<.001	3.68
High	1.91	.36	<.001	6.77
Model Summary				
Constant	.37	.67		
N	1,051			
χ^2 (df = 16)	737.47		<.001	
Nagelkerke R^2	.67			

moderate to strong prediction of the given outcome (Nagelkerke $R^2 = .67$). None of the demographic variables were independently associated with support for GDT when controlling for other factors.

RQ 3 – Does prior knowledge about GDT impact support for this technology?

Opinions about GDT might be influenced by exposure to news media, anecdotes shared by family and friends, or information accessed via the internet and social media. In the current sample, most participants (69.3%) reported some degree of knowledge about GDT prior to the arrival of our survey invitation. This ranged from 34.3% saying they knew "a little bit" about it to 35.0% answering "a fair amount" to "a lot." The sources used for learning about GDT include the news media (82.0% among those with prior knowledge), research reports (42.8%), family, friends, or acquaintances (30.1%), and marketing materials from GDT vendors (7.4%). Table 1 documents the bivariate relationship between prior exposure to GDT and support for its use. People who reported knowing a little bit to a lot about this technology were significantly less likely to want it used in their neighborhood. In the multivariate model (Table 2) only the people who reported knowing a fair amount to a lot about GDT were significantly less likely to support using this technology as compared to people who were hearing about it for the first time.

RQ 4 – Are people <u>more</u> supportive of GDT when they have fewer concerns about privacy?

The majority of respondents expressed some degree of concern regarding GDT's potential impact on privacy and data security, ranging from 43.7% who were somewhat concerned to 36.0% who were very concerned. As hypothesized, people who had fewer concerns about privacy were significantly more likely to support the use of GDT in their neighborhood. Privacy concerns, either somewhat or very concerned, were also negatively associated with support for GDT in the multivariate analysis.

RQ 5 – Are people more likely to support GDT when they are concerned about safety?

Many of the residents surveyed expressed concerns about public safety. This included 68.1% reporting that gun violence was currently a problem in their neighborhood, 46.7% said they worry sometimes, often or very often about being the victim of gun violence, and 36.8% said they feel unsafe or very unsafe walking alone in their neighborhood at night (9.9% for daytime). Table 1 documents how these perceptions were associated with support for GDT. As hypothesized, people were significantly more likely to support the use of this technology when they perceived that gun violence was a problem in their neighborhood, when they felt less safe walking alone, and when they worried more frequently about gun violence. In the multivariate regression analysis only the latter variable was independently associated with support for using GDT.

RQ 6 – Are people who trust their local police more likely to support GDT?

Prior studies find that support for surveillance technologies is closely tied to perceptions regarding the police. We addressed this in the current study by asking respondents whether the local police are trustworthy. More than one-quarter (29.0%) of the participants gave the lowest possible rating on our three trust questions. Roughly one-quarter (23.1%) had what we considered high trust in the police. As hypothesized, these ratings were strongly associated with support for using GDT in one's own neighborhood (see Table 1). Among those with very low trust in the police, just 7.8% supported using this technology. Eight out of ten (82.9%) with high trust in the local police supported the use of GDT. In the multivariate model (Table 2) people with low to moderate trust and those with high trust were significantly more likely to support GDT than those with very low trust.

Discussion

The current study found that GDT is a highly divisive issue in Portland, at least in neighborhoods with above-average rates of validated shootings. Roughly equal proportions of residents in the *Combined* sample supported (48.3%) or opposed (51.7%) the city using GDT in their neighborhood to address gun violence. Those who were opposed to GDT tended to be more strongly opposed, and opposition was more common among respondents from our *Open* nonprobability sample. These findings contrast with prior community surveys, where support for using GDT and positive opinions about its effectiveness were the norm (e.g., Chicago Community Sentiment Survey on Crime and Gunshot Detection, 2022; Haberman et al., 2020; Vovak et al., 2021; see also Teale, 2021). Several factors might account for this difference.

First, the previous surveys had notable methodological limitations that were at least partially addressed in the current study. This includes small samples and significant underrepresentation of certain demographic groups. Second, the cities examined in the prior research (e.g., Chicago, IL, Cincinnati, OH, and Wilmington, DE respectively) are likely to differ from Portland in the prevalence of gun violence, the political leanings of the residents, and police-community relations. All of these factors could impact local opinions about GDT. Third, the surveys in three other sites were conducted after GDT was already in use, whereas the current study queried residents during a period of community dialogue about investing in this technology. Opposition to GDT might decrease over time if concerns about adverse consequences are not realized. Fourth, the current study focused specifically on neighborhoods with higher-than-average rates of firearm discharges. This might make our findings less comparable to those generated via broader community sampling (e.g., Teale, 2021). Finally, the varying levels of support for GDT observed between our *Random* and *Open* samples highlights the potential influence of different sampling procedures. Providing open access to the survey via

social networks (i.e., the *Open* sample) appears to have resulted in a group that was more informed about GDT. One-half (52.4%) of the respondents in the *Open* sample said they knew a "fair amount" to "a lot" about GDT before receiving the survey invitation. This compares to 28.3% in the *Random* sample [χ^2 (2, N = 1,113) = 85.41, $p < .001$].

Consistent with research on other forms of police surveillance, opinions about using GDT in the present sample were closely tied to how people felt about local law enforcement. People who had high trust in the police were much more likely to support the use of GDT in their neighborhood compared to people with low trust. This finding is consistent with research on other surveillance technologies (Bradford et al., 2020; Heen et al., 2018; Merola and Lum, 2014; Nader et al., 2023) and reinforces Tyler's (2003) assertion that trust plays an important role in citizens' willingness to empower the police with legal authority over public safety matters. This apparently includes the use of new police surveillance technologies. Unfortunately, the cross-sectional design used in the current and related studies limits our ability to infer causal relationships between the constructs involved (see for exception Hino, 2022). We do not know whether distrust in the police leads people to oppose GDT or whether one's knowledge about and feelings toward GDT influence how much they trust the police. To this effect, there would be great value in knowing whether trust in the police *changes*, either positively or negatively, as a result of implementing new surveillance practices. What happens, for example, when a large segment of the community is opposed to a given technology and city officials decide to use it anyway? Does this lead to a further loss of trust and can this loss be mitigated by transparent decision-making that grants citizens a voice in the process? Likewise, it would be worth knowing whether governmental actors or agencies increase perceived legitimacy if they decide to forgo a new policing practice based in part on community sentiments.

Another key finding from the current study was that most (79.7%) respondents were somewhat to very concerned about privacy in relation to GDT. Privacy concerns were in turn one of the strongest predictors of opposition to GDT in the bivariate and multivariate analyses. Nearly all (93.0%) of the people who were very concerned about privacy opposed the use of GDT in their neighborhood. These findings are supported by a growing body of research on other forms of police surveillance (Crow et al., 2017; Gurinskaya, 2020; Heen et al., 2018; Kopp and Gardiner, 2021; Merola and Lum, 2014; Miethe et al., 2019; Nader et al., 2023; Nam, 2019; Sakiyama et al., 2017; Saulnier and Thompson, 2016; Sousa et al., 2015) and demonstrate that perceptions about a technology's potential for privacy incursions are a significant impediment to implementing and sustaining new practices. This may be particularly important in democratic, low power-distance cultures like the United States, where privacy is considered by most people to be a fundamental right (Gurinskaya, 2020; Thompson et al., 2020).

Studies addressing other police surveillance technologies find that support for these practices is associated with fear of victimization (Gurinskaya, 2020; Nader et al, 2023), whether a person has been a recent victim of crime (Heen et al., 2018), and the degree to which a person worries about public safety (Bradford et al., 2020). Support for GDT in the present study was similarly associated in the bivariate analyses with the belief that gun violence was a problem in one's neighborhood and with the frequency of worrying about gun violence victimization. We also found that people who felt less safe in their neighborhood were more likely to support the use of GDT. In the multivariate model only the second factor, worry about victimization, uniquely contributed to the prediction of GDT support. The more direct personal risk captured by this variable might account for this finding. Collectively, these findings speak to the possibility of a tradeoff wherein people voluntarily give up some of their privacy rights when they perceive

that a surveillance technology will increase their safety (e.g., Davis and Silver, 2004). Future studies should directly explore Pavone and Esposti's (2010) assertion that this relationship is at least partly mediated by a technology's perceived or real capacity to benefit community safety. At this point, the public safety benefits of GDT are questionable (Choi et al., 2014; Doucette et al., 2021; Lawrence et al., 2018; Mares and Blackburn, 2012, 2020; Mazerolle et al., 1998).

GDT has been used as a police surveillance tool in the U.S. for more than two decades, long enough for the benefits and drawbacks to be covered by the news media and for arguments about privacy invasion and disproportionate impact on people of color (e.g., Chu et al., 2023) to have made their way into the public consciousness. The results of our study suggest that exposure to these resources and greater knowledge of GDT are associated with opposition to the use of this technology in one's neighborhood. This finding highlights another consideration for law enforcement and city administrators who are considering the implementation of a new surveillance practice. Opinions about new technology will likely be impacted by the prevailing sentiments found in these resources. One caveat, however, is that we do not know the exact materials people accessed to learn more about GDT nor the accuracy of this information. Moreover, we are again limited by the cross-sectional nature of the dataset at hand. People who are strongly opposed to a given police surveillance practice might just be more inclined to seek out information from the news media, social media, the internet, or other sources. This highlights an interesting area for future studies: to what extent are opinions about policing practices impacted by how these activities are presented in the news media and other sources?

A final notable outcome from the current study was the limited association observed between a person's demographics and their support for or opposition to GDT. None of the factors that we considered, including gender, age, race, or ethnicity, were independently

associated with GDT in the multivariate model. This suggests that the initial bivariate relationships between gender, age, and support for GDT were better accounted for by other factors in the regression.[1]

Limitations

A major concern with the present research is the generalizability of the findings. The political and criminological context of Portland, our procedures for selecting the 23 target neighborhoods, the timing of the survey (i.e., before implementation of GDT), and local media attention during public deliberations about this technology may have influenced the opinion of our respondents. Moreover, our response rate for the *Random* sample was low. Unfortunately, we are not alone when it comes to the latter issue. Response rates have been declining for decades due in part to survey fatigue and increased use of online tools (Couper, 2017; Daikeler et al., 2020; Stedman et al. 2019). In a recent meta-analysis of educational studies published between 2007 and 2014, the average return rate for online surveys was 44.1% (Wu, Zhao, and Fils-Aime 2022). It is not unusual to see rates for recent social science surveys fall well below this figure, including studies addressing police surveillance technology (e.g., Crow et al., 2017; Lawrence et al., 2023; Merola & Lum, 2014; Nader et al., 2023). Other published studies addressing this topic have relied upon convenience samples (e.g., Gurinskaya, 2020; Kopp & Gardiner, 2021) or online panels (e.g., MTurk; Heen et al., 2018; Miethe et al., 2019; Nelson et al., 2019; Ritchie et al., 2021; Sakiyama et al., 2017), both of which raise concerns about selection bias. Finally, we note that the inverse relationship between response rates and

[1] A further exploration of age was conducted given the associations between this variable and support for GDT at the bivariate level. Age was also correlated with perceived safety (r = -.14, p < .001). Rather than adding interaction terms to the regression, we conducted separate analyses for each age group. The factors predicting support for GDT and the directionality of the associations were largely unaffected by age. The only sizable difference found was for the variable "Gun Violence is a Problem." In the 35 to 54 years old age group this item was a significant predictor of support for GDT (p = .01, OR = 2.36). The item was not associated with support for GDT among those aged 18 to 34 (p = .84, OR = 1.12) or for those aged 55 or older (p = .26, OR = .60).

nonresponse bias is not an invariable law (Groves, 2006). In some cases, the sample size obtained in a survey may be more important for generalizability than the response rate (e.g., Hendra & Hill, 2019). In summary, while our response rate was low, our study generated two independent samples with one being random, we assessed and where indicated reported differences in outcomes across the groups, and the number of respondents in our *Combined* sample was quite high in comparison to related studies.

A second issue that might impact the generalizability of our findings concerns the underrepresentation in our samples for people of color and younger residents as compared to Census figures. The underrepresentation of racial and ethnic minorities in survey research is again not unique to our study - a similar pattern was reported in several of the published works addressing public attitudes toward police surveillance technologies (e.g., Heen, Lieberman and Miethe, 2018; Kopp and Gardiner, 2021; Nelson et al., 2019; Sakiyama et al. 2017). The fact that race and ethnicity were unrelated to support for GDT in the present study potentially mitigates the impact of this issue. As for age, one hypothesis for the underrepresentation of younger people (i.e., 18 to 34) in our samples has to do with the salience of public safety for different age groups. In our *Combined* sample, older respondents reported feeling less safe walking alone in their neighborhood [$F(2, 1094) = 11.00$, $p < .001$]. Perhaps this contributed to older people in our sampling frame completing the survey at a higher rate than younger residents.

A third limitation of the present study is that our survey questions were nonspecific regarding how police would use GDT. Studies with other surveillance technologies find public support varies based on the presentation of contextual information. For instance, Miethe and colleagues (2023) found substantially higher support for police using facial recognition technology to identify terrorists as opposed to managing public order offenses. Likewise,

Sakiyama and colleagues (2017) reported nearly unanimous public support for using drones in search and rescue operations, while fewer than one-half supported using drones for crowd management (see also Bradford et al., 2020; Merola and Lum, 2014; Saulnier and Thompson, 2016). Future studies should explore whether public support for GDT is equally impacted by contextual information. One particularly salient dimension to consider is whether the technology leads to a focus on victims as opposed to offenders. We hypothesize that opposition to GDT might be lower when it is used to expedite medical treatment and transport for those subject to gun-related violence. Other uses for GDT that could be examined include deterring would-be shooters, rapid deployment of officers to increase on-scene arrests, evidence collection, and the identification of hotspots for proactive policing.

Conclusion

The monetary cost of installing and supporting GDT in high-crime areas of a city is significant (e.g., Mares 2023), and the benefits of these devices for public safety remain in doubt. Like most police surveillance practices, GDT can also be a particularly divisive issue among local residents, some of whom will be disproportionally impacted by heightened surveillance and police activity. Within this context, it seems especially important for city and police administrators to be cautious when introducing new policing practices. Investing in public safety strategies that are opposed by large segments of the community might adversely impact police-community relations to a degree that more is lost than gained. The flip side of this coin is that the police may be more effective in their efforts to adopt new surveillance practices when they are actively engaged in and successful with efforts to improve police-community relationships. Community surveys like the one associated with the current study can play a valuable role in assessing both trust in the police and public opinions about new policing practices. It is worth

noting in closing that Portland's Mayor and Police Chief, after reviewing the present survey results and hearing from community members through other channels, decided that investing in GDT was not currently in the best interests of the city.

Word Count = 8,205

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