2022

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Kris Henning
Portland State University, henning@pdx.edu

Christian Peterson
Portland Police Bureau

Greg Stewart
Portland Police Bureau

Kimberly Kahn
Portland State University, kimbkahn@pdx.edu

Yves Labissiere
Portland State University, labissy@pdx.edu

See next page for additional authors

Citation Details

Published as: Henning, K., Peterson, C., Stewart, G., Kahn, K., Labissiere, Y., Renauer, B., ... & Sothern, S. (2022). Getting Proactive with Police Proactivity: The Benefits of Computer-aided Dispatch for Directing Police Resources to Areas of Need. Policing: A Journal of Policy and Practice, 16(3), 427-442.

Authors
Kris Henning, Christian Peterson, Greg Stewart, Kimberly Kahn, Yves Labissiere, Brian Renauer, Renee Mitchell, and Sean Sothern

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Kris Henning[a*], Christian Peterson[b], Greg Stewart[b], Kimberly Kahn[a], Yves Labissiere[a], Brian Renauer[a], Renee Mitchell[c], and Sean Sothern[b]

[a]Portland State University, [b]Portland Police Bureau, [c]RTI International
*Corresponding author: Department of Criminology and Criminal Justice, Portland State University, P.O. Box 751, Portland, OR USA 97201-0751. Phone: 503-725-8520. Email: khenning@pdx.edu

This project was supported by Grant No. 2014-WY-BX-0004 awarded by the Bureau of Justice Assistance (BJA). The Bureau of Justice Assistance is a component of the Office of Justice Programs, which also includes the Bureau of Justice Statistics, the National Institute of Justice, the Office of Juvenile Justice and Delinquency Prevention, and the Office for Victims of Crime. Points of view or opinions in this document are those of the author and do not represent the official position or policies of the United State Department of Justice.

Abstract

Sherman and colleagues (2014) argue that crime reductions associated with hot spot policing can be maximized by carefully managing the dosage of supplemental resources delivered. Fully achieving this goal in prior studies has been difficult due to resistance by officers, the use of atypical strategies for directing patrols to target locations, and insufficient attention to the measurement of treatment dosages. This has led to calls for process research examining the implementation of hot spot policing in law enforcement agencies. The current study represents one such effort. The computer-aided dispatch (CAD) system for a large U.S. police department was pre-programmed with 16,200 supplemental community engagement patrols that were communicated to officers similar to emergency calls for service generated by the public. An interdisciplinary team comprised of sworn officers, crime analysts, and academics designed and evaluated the intervention using an experimental design. The team found that the vast majority of patrols were delivered as scheduled (n = 12,965; 80.0%) and that planned dosage ratios between treatment conditions were achieved. Advantages of using CAD for proactive policing initiatives and benefits of police-academic partnerships are discussed.

Keywords: law enforcement, police proactivity, directed patrol, hot spots, community engagement

Getting Proactive with Police Proactivity: The Benefits of Computer-Aided Dispatch for Directing Police Resources to Areas of Need

A recent report from the National Academies of Sciences (NAS, 2018) offered a clear distinction between proactive policing, involving strategic efforts to use police resources for crime prevention, and reactive policing, wherein officers focus on responding to incidents that have already happened. Research on the latter raises serious doubts regarding the benefits of these practices for crime control (e.g., Greenwood et al., 1975; Kelling, Pate, Dieckman, & Brown, 1974; Spelman and Brown, 1984). By contrast, a large and growing body of research on proactive policing finds that certain strategies are associated with significant reductions in offending. One of the most well-researched strategies, hot spot policing, involves the delivery of supplemental police resources to micro locations with high concentrations of crime. Fully implementing and sustaining this practice has proven to be difficult, however, leading to calls for process-oriented research on alternative implementation strategies (NAS, 2018). The current study represents one such effort.

In 2014 an interdisciplinary team in Portland Oregon collaborated to design, implement, and evaluate a new approach to delivering supplemental police resources to areas of need and for carefully measuring the dosage of services delivered.[1] Rather than give officers a list of target areas to patrol at their discretion, a common approach used in prior hot spot studies, the team front-loaded 16,200 directed community engagement patrol (CEP) calls into the police bureau's Computer-Aided Dispatch (CAD) system. Similar to emergency 911 calls generated by the public, the CEPs were sent to officers at pre-determined times via their patrol vehicle's mobile data terminal (MDT). The primary objective of the current research was to evaluate the effectiveness of CAD in delivering varying dosages of CEPs to

[1]Police-academic partnerships have been criticized for yielding greater benefits for the latter. For example, while many published studies result from collaborations, practitioners are rarely given credit for their contributions when it comes to authoring journal articles (Jenkins, 2015). On this project, we agreed up front that all eight team members would receive co-authorship on any academic presentations and publications that resulted from our work.

targeted areas of need. Details on the intervention and use of CAD are provided following a brief review of the research on hot spot policing.

Hot Spot Policing

Studies consistently find that crime is heavily concentrated in most cities and that offending rates in these areas are often stable over time (Sherman et al., 1989; Weisburd, 2015; Weisburd, Bushway, Lum & Yang, 2004). Increasing police activity (e.g., foot patrols, traffic stops, problem-solving) in hot spots appears to reduce crime and calls for service (Braga et al., 2014; 2019). Importantly, the benefits associated with this strategy do not come at the cost of crime displacement in surrounding areas (Bowers et al., 2011). Nor is there evidence that increasing police activity in crime hot spots invariably harms police-community relations (Kahn et al., 2019; Ratcliffe et al., 2015; Weisburd et al., 2011).

While existing studies highlight the potential benefits of hot spot policing, significant gaps remain in our knowledge regarding the implementation of this strategy outside of well-funded field experiments. Many law enforcement agencies have experienced reductions in staffing over the past decade (Hyland & Davis, 2019) and recent calls for de-funding may exacerbate this trend (Police Executive Research Forum, 2021). Interventions that require doubling patrol levels (e.g., Sherman & Weisburd, 1995) or deploying officers to a hot spot for their entire shift (e.g., Ratcliffe, Taniguchi, Groff, & Wood, 2011) may not be feasible for most agencies. Further research is needed to document the dose-response relationship between supplemental patrol resources and crime and to identify the minimum dosage needed to impact the latter. This in turn, requires the development of a standardized approach for measuring patrol dosages. Sherman and colleagues (2014) define a patrol *dosage* as the total amount of time that officers spend in a target location. A given dosage is comprised of three independent components: the *dose*, or the amount of time spent on location during each patrol, the *frequency*, the number of visits made per day, and the *duration*, the number of days the intervention runs. Most of the existing studies on policing hot spots fail to carefully document these parameters, limiting our ability to replicate findings, systematically analyze the literature, and provide guidance to law enforcement agencies (NAS, 2018; Sherman et. al., 2014).

Implementing new hot spot policing initiatives with high fidelity and sustaining them over time has also proven to be difficult. Santos and Santos (2019) argue that policing strategies are only sustained when they are fully integrated into an organization's culture and operating procedures, something that has yet to be achieved with hot spot policing. Sherman and Weisburd (1995), for example, noted significant officer resistance to directed patrols in one of the first studies of this practice. Likewise, subsequent field experiments have found it difficult to obtain full cooperation with treatment delivery and reporting protocols (e.g., Ariel, Weinborn, & Sherman, 2016; Sorg, Wood, Groff, & Ratcliffe, 2014; Weisburd, 2005). Some of the challenges in securing officers' compliance may have resulted from the way supplemental patrols were administered in these studies. A common practice is to give officers a list of hot spots in their patrol region, ask them to visit each location during their shift, and then document their visits via supplemental paperwork.[2] This practice stands in sharp contrast to how police agencies manage emergency calls for service generated by the community. Here, agencies use CAD systems and MDTs in patrol vehicles to direct officers to the scene and document their work (Lum et al., 2020). Efforts are needed to design and institutionalize a similar strategy for administering proactive policing interventions.

Portland's Community Engagement Patrol Experiment

In 2013 the City of Portland, following nearly two decades of declining offense rates, experienced a notable rise in crime. This came at a time of diminishing resources for the city and the police bureau more specifically. Portland's population grew by 4.7% from 2009 to 2013 while the number of uniformed patrol officers declined 5.9%.[3] During this same period the U.S. Department of Justice entered into a settlement agreement with the city to address a pattern or practice of excessive force against people with mental illness. One of the requirements of the agreement was for the police to develop new strategies for community engagement.

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[2] Many of the studies listed in Braga and colleagues' (2019) most recent meta-analysis of hot spot policing provide little to no information on how the delivery of supplemental police activity was managed.

[3] States in the Western part of the U.S. often have lower staffing levels compared to the rest of the country (Hollis & Wilson, 2015), and Portland's rate of officers per 1,000 residents was already well below both regional and national levels for cities with a population of 500,000 or more.

Faced with demands to improve police-community relations and address rising crime, (then) police Chief Mike Reese asked his crime analysis unit (Sgt. Greg Stewart, Analyst Christian Peterson, and Officer Sean Sothern) to form a response team. Sgt. Renee Mitchell was brought on as a consultant based on her recent involvement in a field experiment testing hot spot policing in Sacramento, CA (Telep, Mitchell & Weisburd, 2012). Additional team members were added via a long-standing police-academic partnership with Portland State University, including Drs. Kris Henning, Brian Renauer, Kimberly Kahn, and Yves Labissiere. The end result of several months of dialogue and pilot-testing was a community-oriented approach to policing hot spots. Rather than increasing enforcement, the Chief directed the agency to send CEPs into high crime areas. As stated in roll-calls and several electronic communications that went out to every sworn officer: 'The Chief's intent for this initiative is to carve out dedicated time for officers to engage with community members in areas that are experiencing high volumes of crime and/or livability concerns.'[4]

Prioritization of brief non-investigative contacts with community members in Portland's community engagement intervention represented an innovation and deviation from prior directed patrol studies, where increased enforcement and a focus on crime reduction is the norm. Our primary goal was to increase positive contacts with residents and businesses in the target locations, with the desired outcome of improving trust in the police. That said, we also believed that the increasing the visibility of officers in these areas had the potential to reduce crime. Sherman (1990) argues that the primary value of additional police presence in a hot spot is the immediate and residual deterrence generated by increasing perceived risk among would-be offenders. Relatively few people are willing to openly engage in criminal activity within eye-sight of an officer. This holds true regardless of whether the officer has been instructed to aggressively enforce the law or interact positively with residents.

[4] Officers were provided guidance on different types of non-investigative interactions they could pursue during the CEPs. This included foot patrols, 'meet & greets' with residents, business checks, brief crime prevention activities, and other efforts to positively engage with the public. It is important to note that officers were not prohibited from making traffic or pedestrian stops during the CEPs. Instead, communications went out advising officers that stops and other forms of investigation should not be their default activity.

Portland's CEP program differed from past directed patrol studies in two other ways that are of critical concern to the current paper. First, we developed an innovative strategy for scheduling the CEPs and getting patrol officers into the target locations. Consistent with most agencies (Lum et al., 2020), the local CAD system is used to dispatch officers in response to emergency calls from the public. The police bureau also uses the CAD to track officers' self-initiated activities like traffic stops, crime follow-ups, and area checks. A third type of call, directed CEP, was added for the current initiative. Directed patrols allow administrators and crime analysts to be more involved in delivering supplemental police resources to areas of need. In the current study this involved scheduling 16,200 CEPs in the CAD.[5] Second, we investigated three distinct dosage levels. Some locations were scheduled to receive two supplemental patrols per day, others would receive four, and a third set served as the *treatment as usual* control group (i.e., no CEPs).

Objectives

The primary goal of the current study was to evaluate the effectiveness of CAD in delivering different CEP dosages to high crime areas. The planned dose for the current study was 15 minutes per patrol. This decision was based on prior research suggesting diminishing returns with longer visits (Koper, 1995). Our patrol frequency for the treatment conditions was scheduled to be either two or four times per day and the intervention lasted 90 consecutive days in each of the target locations. Based on these parameters, we planned to deliver three distinct dosages of supplemental patrol to our hot spots, producing a 2:1:0 ratio between the treatment groups and control condition. The analysis presented below assesses whether these objectives regarding dose, frequency, and final dosage were achieved.

A second objective was to explore the utility of CAD with regard to three other aspects of patrol dosing that have been largely ignored in prior research. Sherman and colleagues (2014) argue that supplemental police activity will have the greatest impact when these visits coincide with peak times of criminal activity in the target locations. Likewise, they postulate that crime prevention can be maximized

[5] The CAD vendor awarded two of the co-authors, Peterson and Sothern, a technical solution award for their work on the batch upload system used in scheduling the CEPs.

if the timing of the additional patrol activity varies from day to day, making it difficult for potential offenders to predict the officer's arrival. The third topic concerns officers' reaction to increased patrol activity in hot spot policing initiatives. Prior studies have generally assumed that delivering a supplemental patrol dosage has no impact on officers' self-initiated activity in these locations (for exception see Telep et al., 2014). Patrol officers usually have unallocated time (Famega, 2005; Famega, Frank, & Mazerolle, 2005), much of which is spent in self-directed activities like traffic stops, follow-up contacts, and issuing parking citations (Lum et al., 2020). We were concerned that officers might decrease their self-initiated activity in the treatment locations if they were directed there two to four times per day for the CEPs. This could substantially influence the overall dosage of police activity actually delivered and would represent a serious threat to the fidelity of our intervention. The current study addresses the first two issues, timing and randomness of patrols, by examining the delivery of CEPs via the CAD system and comparing these data to historical crime trends. The third issue, the potential impact of directed patrols on officers' self-initiated activity, is addressed by comparing the frequency of these calls from before and during the CEP intervention.

The final process evaluation questions we address in the current study include the following:[6]

1. Was the CAD system effective in delivering the planned frequency, dose, and dosage of CEPs to the target locations?
2. Did the timing of the CEPs match peak periods of criminal offending in the target locations?
3. Did administration of the CEPs via the CAD system lead to a degree of randomness in the arrival times of the officers?
4. Did officers compensate for the new directed patrols by decreasing their self-initiated activity in the target locations?

Methods

Procedures

The target locations for the current study were identified using several steps. The research team started with all of the criminal offenses and 911 police dispatch calls for the city of Portland from 2011 to

[6] The findings from the outcome evaluation are available in the final report submitted to the Bureau of Justice Assistance (BJA; Henning et al., 2017; see also Kahn, et al., 2019).

2013. Incidents were geocoded, projected onto a 500’ x 500’ grid overlaying the city, and aggregated by year. A composite risk score was calculated for the grid cells that gave equal weight to offenses and 911 calls, with greater weight to more recent incidents. The 312 locations with the highest risk scores in the city were subjected to scrutiny by crime analysts and several patrol sergeants. Roughly one-half of the locations (*n* = 136) were removed to ensure a 1,000’ buffer surrounding each area. Other locations (*n* = 86) were removed because they were on a city border, they contained a structure that generates police calls (e.g., hospital, jail, police facility), or they were already participating in another crime prevention initiative. The end result was 90 500’ x 500’ locations with higher than average crime and calls for service in the preceding years, each with a minimum 1,000’ separation from other study areas and bordering jurisdictions.

A block randomization process was used to assign the 90 locations to our control (*n* = 30) and two treatment conditions (2 CEPs per day, 4 CEPs per day; *n* = 30 each). Blocking increases the odds of achieving balanced groups when using random assignment and small samples (Weisburd & Gill, 2014). Officers’ self-initiated calls in 2013 were totaled for each hot spot and the resulting dataset was sorted in descending order. The three locations with the highest self-initiated activity formed the first block. Within this block, one location was randomly assigned to each study condition. This process was repeated until all 90 hot spots were allocated.

The police bureau’s CAD system, as noted previously, was pre-programmed with all of the CEP calls for the experiment. The 60 treatment hot spots were each scheduled to receive 90 consecutive days of supplemental patrols, resulting in a total of 16,200 CEPs front-loaded into CAD. Under ideal circumstances the project team would have identified the unique temporal pattern for each hot spot and then scheduled the CEPs to coincide with the hours of peak activity. Practical considerations made this unfeasible. Care had to be taken to avoid shift changes and overburdening officers with too many calls per patrol District and Precinct. Rather than individually matching the hot spots and CEPs, we examined the aggregate temporal distribution of dispatch calls and offenses during the study months for the preceding years. These data were used to guide the hourly distribution of the CEPs in the schedule. The timing of the calls was also shifted every 15 days to make them less predictable.

The CEP experiment ran for six consecutive months in 2014. The intervention was delivered in three phases to avoid overwhelming the agency. The phases consisted of 10 hot spots from each study condition going active for 90 days. Hot spots in phase I were active from March 18th through June 15th, phase II sites were active from May 2nd through July 30th, and phase III sites were active June 16th until September 13th. During the 180-day experiment, this meant that officers were dispatched to treatment areas either 60 or 120 times per day.

Data Sources

The police bureau's CAD system provided most of the data used in the current research, including details on all 16,200 CEPs. The available data documented the location of the call (i.e., hot spot ID), the date and time it was scheduled to go out, and whether the call was actually issued versus being cancelled preemptively. For the CEPs issued (i.e., presented to officers via their MDT), the system recorded the time spent in queue, how long it took the officer to travel to the hot spot, and the number of minutes to 'clear' or complete the call. These same data fields allowed us to identify CEPs that were issued in CAD, but left unclaimed until they were closed without a response. Finally, the CAD system had an open text field or *clearing remarks* that some officers used for documenting additional details about their CEPs.

CAD data was also used to document officers' self-initiated activity in the 90 hot spots before and during the intervention. Similarly, the research team had access to CAD data on 911 dispatch calls generated by the community. Lastly, the agency's criminal incident reporting system documented the major crimes in each hot spot for the years preceding the study.

Results

Frequency

The first set of analyses examine the degree of success achieved using the CAD system to deliver the planned frequencies of supplemental patrol activity to the 90 hot spots. Consistent with the study's design, data from the CAD system verified that no CEPs were delivered to the 30 control locations (see Table 1). In the 2 CEPs per day condition, there were a total of 5,400 CEPs scheduled (30 hot spots x 90 days x 2 per day). Patrol officers successfully completed 4,224 (78.2%) of these calls with a visit to the target location.[7] This averages to 1.6 CEPs per day per location. With the 4 CEPs per day condition, 10,800 patrols (30 x 90 x 4) were scheduled and 8,741 (80.9%) were successfully completed, producing an average of 3.2 visits per day per location. The proportion of CEPs completed was slightly higher (Phi = .03) in the latter group, $\chi^2 = 16.58$, $p < .001$. This was surprising given the burden of two additional patrols scheduled per day.

Although the aggregate number of CEPs delivered per study condition was largely consistent with the study design, it is possible that individual hot spots within the two treatment groups received varying, possibly overlapping patrol frequencies. Descriptive statistics for the CEPs completed in each treatment condition are presented in Table 1. None of the 30 hot spots in the 2 CEPs per day group received the full allotment of 180 supplemental patrols. The number of completed patrols ranged from 102 (1.1 per day) to 172 (1.9 per day), with an average of 140.8. In the 4 CEPs per day group, where 360 patrols were scheduled, the number delivered ranged from 230 (2.6 per day) to 331 (3.7 per day), with an average of 291.4 patrols. The difference between the two groups was statistically significant, $F(1,58) = 742.21$, $p < .001$, producing a very large effect size (Cohen's $d = 7.03$).

Collectively, these analyses demonstrate that pre-programming the CEPs into the CAD system helped achieve non-overlapping frequencies of supplemental patrol activity across the three study conditions. It is worth noting, however, that a sizable proportion ($n = 3,235$; 20.0%) of the CEPs scheduled were not completed. The majority of these calls ($n = 1,735$; 53.6%) were canceled preemptively by police administrators due to upcoming staffing shortages. For example, all CEPs scheduled for July 4th were eliminated to ensure adequate availability of officers to cover community

[7] The CAD system did not provide GPS coordinates that would have allowed us to verify an officer's exact location during the CEP. Safety protocols and police bureau policy dictate that officers accurately report their location to dispatchers when they take a call. This was also true for the CEPs. We are confident, therefore, that officers were usually in the correct location when they took these calls.

events. The remaining 1,500 CEPs (46.4%) were cancelled by a supervisor or patrol officer *after* the call was issued in the CAD system. In one-half of these cases (n = 749) comments were available in the CAD system's clearing remarks documenting the reason for the cancellation.

The most common explanation for cancelling a call was that officers or the precinct in general were too busy with higher priority incidents (e.g., 'Heavy call load'; 'Unable to complete hot spot due to homicide'). In some cases, officers expressed frustration about having patrolled the same area earlier in the day and cancelled the call (e.g., 'Was on CEP 3 hrs ago at same location, not going back again, too busy.'; 'Three CEPs here in one shift seems excessive.'). Other calls were closed because the officer involved or other agency personnel had recently been in the area (e.g., 'Traffic trainees have been doing stops there for the last two hours.'; 'Been here for a while working on a different call so clearing this out.').

The proportion of CEPs successfully completed also decreased significantly during the study, from 90.7% in March to 76.2% in September. Several factors contributed to this decline. First, dispatchers and police administrators did not initially know how to preemptively cancel the pre-programmed CAD calls. Second, as the study moved into the summer months there was higher demand on officers' time from other calls. Third, officers and supervisors grew increasingly fatigued by the demands of the experiment. The police bureau recorded an average of 780 dispatch and 395 officer-initiated calls per day during 2014. The addition of the CEPs increased the agency's overall call load by 10.2% (120 calls per day) during the study's most active period when two implementation phases overlapped.

Dose

Consistent with other studies on hot spot policing (e.g., Ariel et al., 2017; Haberman & Stiver, 2019; Telep et al., 2012), the planned dose for the CEPs was roughly 15 minutes per patrol. Table 2 provides the descriptive statistics on the average patrol dose per hot spot for the three study conditions. The average length of time officers spent in the hot spots for completed calls ended up being longer than planned. In the 2 CEPs per day condition this ranged from 16:25 (minutes and seconds) to 25:20, with an average of 20:47 or 38.5% longer than planned. In the 4 CEPs per day group the range was 17:40 to

24:31, with an average of 20:56 (39.6% longer than planned). The difference between the two conditions was not statistically significant, $F(1,58) = .09$, $p = .76$.

Looking at the individual CEPs across groups, we found that more than one-third of the calls (37.8%) were completed in the range of 15 +/- 2 minutes. Extending the range a bit further to 15 +/- 5 minutes, accounted for 60.0% of the CEPs. These findings indicate that officers usually complied with the directive to spend roughly 15 minutes per call. The average dose was higher because there were a number of calls ($n = 555$; 4.3% of total) that lasted more than 45 minutes. A brief review of the clearing remarks available for a portion of these calls suggests that many involved some type of enforcement or investigation (e.g., 'Arrested subject with warrant that was pacing the block and peering into businesses'; 'Drinker cited, detox'). In other cases, the officer was held up due to a public safety incident, a recent crime, or a community interaction that required additional time. A smaller number of CEPs (n = 239, 1.8%) were cleared in less than two minutes. The most common explanation for this was that the officer or other agency personnel were already in the hot spot when the call came out.

Dosage

With regard to total dosage, the goal was for officers to deliver 1,350 hours of supplemental patrol activity in the 2 CEPs per day condition (see Table 3). This was based on 30 hot spots for 90 days at 2 patrols per day, each lasting 15 minutes. Officers ended up being on scene 8.6% longer than expected; 1,466 hours in total for the 2 CEPs per day condition. The same basic pattern was found in the 4 CEPs per day condition. Officers delivered 3,061 hours of supplemental patrol or 13.4% more time than the 2,700 hours originally scheduled. Importantly, the planned dosage ratio of 2:1 between the two treatment groups was largely achieved (2.1:1).

Analyses were also conducted looking at variability in patrols dosages at the individual level of analysis (i.e., per hot spot; see Table 3). The hot spots receiving 2 CEPs per day were each scheduled to receive 45 hours of supplemental patrol over the course of the study. Officers delivered between 30 hours and 67 hours in these locations, with an average of 48.9 hours. The hot spots in the 4 CEPs per day group were scheduled to receive 90 hours of additional patrol time each. The amount delivered ranged from a low of 68 hours to 126 hours, with an average of 102.1 hours. The difference between the treatment groups was statistically significant, $F(1,58) = 303.76$, $p < .001$, producing a very large effect size (Cohen's $d = 4.50$).

Peak Times of Criminal Activity

The next analysis evaluates whether the CEPs were delivered during peak periods of criminal activity in the 60 treatment locations. Figure 1 shows the distribution of CEPs by arrival time and day of week. This is contrasted with a line chart documenting the occurred time and day of week for criminal offenses in the preceding two years (2012-2013), limited to the study period of March 18th to September 13th. The times of day have been grouped into three-hour clusters to simplify the visualization.

A preliminary inspection of Figure 1 suggests a high degree of correspondence between the delivery of the CEPs and the occurrence of crime in these locations. Further inspection highlights several moderate discrepancies in the distribution of these events. For example, the frequency of criminal activity generally rose throughout the week from Sunday (12.5% of offenses) to a peak on Friday (16.2%), while the number of CEPs delivered was more consistent across these days (range = 13.7% to 15.0%). Next, looking across day of week, we found that the 9am to 11am period accounted for a larger proportion of CEPs (16.2%) than crime (8.9%). The same was true for noon to 2pm (19.9% vs. 14.8%). Conversely, in the 3pm to 5pm time slot the proportion of CEPs delivered was noticeably lower than what we found for crime (9.3% vs. 19.7%). The latter was largely due to our efforts to avoid scheduling CEPs for the agency's 4pm shift change.

Another way of looking at the correspondence between the timing of the CEPs and crime is to identify the four time of day clusters within each day of week that accounted for the most crime. When these 28 periods were combined they accounted for 71.5% of the criminal offenses from the preceding years. These same time slots accounted for 72.4% of the CEPs. Finally, we ran a correlation between the proportion of offenses per 3-hour cluster and day of week combination ($n = 56$) with the same for our completed CEPs. There was a large association between the two factors ($r = .69$, $p < .001$). Based on these analyses we concluded that the temporal distribution of the CEPs during the study was largely consistent with historical periods of peak criminal activity in our 60 treatment locations.

Predictability of Patrols

Several features of our CAD scheduling system contributed to a degree of randomness in timing of the patrols delivered. First, the CEPs were intentionally dispersed throughout the day to accommodate different shifts and to avoid overtaxing officers at the Precinct level. Second, the schedulers shifted the timing of the pre-programmed CEPs every 15 days to enhance unpredictability for would-be offenders. Third, as noted earlier, a sizable proportion (20.0%) of the calls were cancelled. Fourth, the CEPs were issued in the CAD system as lower priority, meaning that officers sometimes delayed taking them due to higher priority calls. These delays varied considerably, with an average time in queue of 26 minutes (*SD* = 27 min). Finally, officers had to drive to each location and travel times (*M* = 6 min; *SD* = 7 min) were impacted by weather, traffic density, and their starting location.

Figure 2 provides a visual demonstration of the variability achieved in the timing of the CEPs. The figure shows the starting times for completed calls in one randomly selected hot spot from the 4 CEPs per day condition. Time of day in 30-minute increments is plotted along the vertical axis and the horizontal axis presents the first 45 days of intervention. The red squares indicate the officer's arrival time on scene. While some patterns are evident in the data (e.g., no visits during the 4-5 pm shift change), we still see considerable variability in the timing of the CEPs delivered to this location. Whether this in enough 'randomness' to maximize the deterrent potential of supplemental patrols is difficult to say, given the absence of an existing standard in the scientific literature.

Impact on Self-Initiated Activity

Our final analysis assessed whether officers decreased their proactivity in the 60 treatment locations given that they were already being directed there two to four times per day for the CEPs. Proactivity included actions like traffic stops, parking citations, and checks on suspicious activity that officers initiated of their own accord (i.e., not associated with the CEPs). This work is often measured using self-initiated calls recorded in a CAD system (Lum et al., 2020; Wu & Lum, 2017, 2019). CAD is a good source for these data because safety protocols dictate that officers alert dispatch whenever they initiate an investigation or enforcement action while on patrol. We used these data to assess changes in officers' proactivity over two time periods: 90 days prior to the CEP intervention and 90 days during the intervention.

The number of pre-intervention self-initiated calls for the 30 control locations (*M* = 33.5, *SD* = 29.0), 30 hot spots scheduled for 2 CEPs per day (*M* = 24.6, *SD* = 22.6), and the 30 hot spots assigned 4 CEPs per day (*M* = 33.9, *SD* = 32.4) were comparable, $F(2,87) = 1.03$, $p = .36$. During the active phase of the 90-day intervention self-initiated activity went down slightly for the control group (difference score, *M* = -.9, *SD* = 12.9) and 4 CEPs per day groups (*M* = -3.2, *SD* = 15.8), but went up for the 2 CEPs per day condition (*M* = 1.5, *SD* = 10.6). These differences were not statistically significant: $F(2,87) = .97$, $p = .38$. Based on these analyses, we saw no evidence that officers changed their level of proactivity in response to the demands of the supplemental CEPs.

Discussion

Given the evidence that hot spot policing can be effective in preventing crime (Braga et al., 2019; NAS, 2018), it is imperative that researchers identify strategies for maximizing the benefits of this practice and ensure its sustainability (Famega et al., 2017). One consideration in this regard is the identification of an efficient method for directing supplemental police resources to targeted areas. The current study suggests that pre-programming directed patrols into a CAD system can help achieve this goal, providing an innovative solution with high levels of flexibility and adaptability to current policing demands.

Portland's CEP experiment used the CAD system to proactively deliver varying dosages of supplemental police activity, in this case community engagement, to areas of need. More than three quarters (78%) of the CEP calls were completed in the 2 CEPs per day condition, while in the 4 CEPs per day condition, 81% of calls were delivered. Further, the planned 2:1 dosage ratio between the treatment conditions was successfully executed. Once in the targeted locations, officers typically delivered 15 minutes (+/- 5) of patrol activity, the optimal amount recommended based on prior research (Koper, 1995). Front-loading the CEPs into the CAD system helped ensure that the timing of the completed CEP calls coincided with historical periods of peak criminal activity in the target locations and it generated a degree of randomness in arrival times that might aid in the deterrence of crime (Sherman, 1990; Sherman et al., 2014). Finally, CAD data proved useful in verifying that the supplemental patrols had no appreciable impact on officers' self-initiated activity in the areas targeted.

The Portland Police Bureau's use of the CAD system to proactively schedule and dispatch patrols during the CEP initiative appears to be a relatively novel approach to hot spot policing. Law enforcement agencies typically use their CAD system to dispatch officers in response to emergency calls from the community. Many agencies also use the CAD system for tracking officers' self-initiated activity, albeit often with a lesser degree of success (Lum et al., 2020). For the CEP intervention the agency developed a third type of call in the CAD system: directed patrol. It was, in effect, an administratively defined call, designed to meet a specific organizational objective. This level of control over an individual officer's proactivity has research, strategic, and operational benefits.

From a research perspective, using the CAD system for directed patrol provides advantages compared to existing procedures. Prior studies have often granted officers considerable discretion with regard to how often they visit the target locations, when they arrive, and how long they stay. This can result in a lower dosage of patrol activity being delivered and a failure to optimize parameters that might generate a larger impact on crime (Sherman et al., 2014). As demonstrated in the current study, front-loading calls into the CAD system can help to accurately control the patrol frequency, dose, and the overall dosage delivered to a target location, as well as monitor implementation fidelity.[8] Used in this way, CAD could help standardize the delivery and measurement of directed patrol dosing across diverse policing missions. This would greatly benefit replication studies and meta-analytic reviews, advancing our ability to generalize the findings from research.

[8]Automatic Vehicle Location (AVL) systems and other forms of GPS tracking also have great promise with regard to measuring patrol dosages and monitoring compliance (Ariel & Partridge, 2017; Weisburd et al., 2015). A key distinction between these systems and CAD is that the former are not currently used to direct officers to calls for service.

With regard to strategic initiatives, directed patrols dispatched through an agency's CAD system provides administrators with a new tool for managing unallocated time available with patrol officers (Famega, 2005; Famega, Frank, & Mazerolle, 2005). The current intervention, for example, allowed the police bureau to deliver 4,527 additional hours of supplemental patrol with a focus on community engagement. Following the conclusion of the CEP experiment, the agency moved quickly to apply this technique to other strategic objectives. This included programming CAD with patrols to verify the home address of registered sex offenders, deter car break-ins at downtown parking garages, engage community members in gang impacted areas, deliver foot patrols in a high crime neighborhood, and conduct community outreach at school events.[9] While these subsequent initiatives were not subject to empirical evaluation, anecdotal feedback suggest they were beneficial and supervisors valued the additional control this practice afforded over their patrol resources.

Operationally, directed patrols run through a CAD system could allow police leaders to better align their tactical resources with the agency's strategic objectives. Notably, directed patrol takes proactivity out of the sole discretion of street officers and shares it with police administrators. This increases the opportunities to coordinate patrol activities with crime analysis and creates new opportunities for testing alternative policing strategies. Additionally, in the context of possible de-policing (i.e., reduced self-initiated activity on the part of officers), shared responsibility for managing proactive behavior could provide officers with a degree of protection necessary for initiating discretionary actions in high-risk circumstances (Oliver, 2017; Wolfe & Nix, 2016).

Another benefit of using the CAD system to direct patrols was the relative ease of implementation in the current project. Braga and Weisburd (2006) note that police are more likely to adopt innovations that require the least departure from their hierarchical organizational structure. Similarly, Greenhalgh and colleagues' (2004) systematic review on the diffusion of innovation in service organizations notes that compatibility with organizational norms and operating procedures is a strong

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[9]Readers interested in learning more about these interventions should contact Christian Peterson at the Portland Police Bureau (Christian.R.Peterson@portlandoregon.gov).

determinant of adoption. CAD is based on existing technology and its use for scheduling directed patrols represents a relatively small departure from standard practice. This is not to say that pre-programming CAD with directed patrols has no inherent challenges. In the current study dispatch supervisors and police administrators were able to pre-emptively cancel the CEPs and there is evidence that this action increased over the course of the study. Similarly, individual patrol officers left some CEP calls open in the CAD, while others were cleared almost immediately when they were issued. As they say, even the best laid plans can go awry and individuals in any profession will find ways to reassert their autonomy when they feel it has been restricted. Fortunately, CAD affords agencies with opportunities for tracking some of these reactions.

Portland's CEP experiment also highlights some of the benefits associated with police-academic partnerships. As noted previously, this intervention was designed, implemented, and evaluated by a team comprised of crime analysts, sworn officers, and academics. Partnerships like this have been actively supported through a variety of federal programs and most of the current authors have participated in several of these initiatives. Police-academic partnerships are still rare, however, with only one-third of U.S. law enforcement agencies reporting a collaboration in the preceding five years (Rojek et al., 2019). Impediments to collaboration between police and academics include differing perspectives regarding the topics needing study (operational efficiency vs. critical criminology), focal area (what works for this agency vs. what works for policing more broadly), urgency (need to know now vs. willing to wait years), imbalance in the distribution of risks and rewards (political environment and at-will appointments vs. tenure and academic freedom), scale (small N and case studies valued vs. large samples to maximize statistical power), and different thresholds for determining success (practical vs. statistical significance: Engel & Whalen, 2010; Henning & Stewart, 2015).

Partnerships that are able to overcome these challenges yield benefits to each party. Starting with the police, academics bring a wealth of knowledge regarding the scientific literature. In the current project, this helped to identify critical gaps that merited exploration (i.e., impact of patrol dosage). Academics have advanced training in methods and statistics that benefit the development of a strong research design. Our team, for example, advocated for the use of a randomized experiment with blocking to increase the likelihood of achieving equivalent groups at the start of the study. Practitioners also benefit from access to academic's expertise in data collection. Members of our team had significant experience conducting community surveys, facilitating the effort to assess the impact of the CEPs on residents. Finally, academics are trained to be neutral, skeptical, and independent and most work in an environment that affords considerable autonomy. This can bring a degree of external validity to a project that would otherwise function under a hierarchal command structure and, potentially, experience pressure to deliver positive findings.

The benefits available to academics who partner with law enforcement agencies are equally salient. Partnering with an agency provides the applied-minded academic with the opportunity to work in the 'real world'. This helps academics appreciate challenges facing the policing profession and can lead to the identification of new research projects that are mutually beneficial. Portland's CEP experiment, for example, developed out of a long-standing police-academic partnership and discussions on policing crime hot spots in the context of diminishing patrol resources. Developing and maintaining partnerships with police agencies gives the academic access to data that would otherwise be difficult to obtain. With the CEP study this included city-wide access to police calls for service, self-initiated calls, criminal incident reports, and community surveys. These data have been and will continue to be used in generating scholarly works. Similar to the validity gains for police agencies, individual academics and universities often benefit from working in applied settings (i.e., 'street cred'). Portland State University's motto is 'Let Knowledge Serve the City' and the participating academics used this work to demonstrate their commitment to this objective. Finally, and perhaps most important, research studies conducted in full partnership with practitioners usually yield a better intervention. The academics on our team knew a lot about the literature, methods, data collection, and statistics, but they knew little about dispatching patrol officers, communicating new tactics within an agency, and obtaining compliance with an intervention that increased the agency's call load by 5-10%. The content expertise, institutional history and relationships that our police members brought to the partnership were crucial during the implementation of the CEP program.

In conclusion, the findings from Portland's CEP study suggest that CAD can be used to efficiently direct supplemental police resources to areas of need. The creation of CAD calls designed specifically to meet strategic objectives, as opposed to responding reactively to crime, represents an innovative step forward in how police operationalize and manage proactivity. Directed patrols administered and measured via CAD allow police leadership to provide more guidance on when, where, and how patrol officers use their uncommitted time. This includes facilitating positive interactions with the residents that, potentially with the right dosage and training, could decrease crime and improve police-community relations in areas where trust has been eroded.

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Author Bios

Kris Henning, Ph.D., is a Professor of Criminology and Criminal Justice at Portland State University. He earned his Ph.D. in clinical psychology from the University of Vermont, leading to 25 years of teaching and applied research addressing crime and criminal justice. His work in this area has been supported by local and federal grants, including the National Institute of Justice (NIJ; Strategic Approaches to Community Safety Initiative) and the Bureau of Justice Assistance (BJA; Community-Based Crime Reduction, Smart Policing Initiative, Project Safe Neighborhoods).

Christian Peterson, MS, is the Acting Police Data Research Supervisor at the Portland Police Bureau. As a leader in the Strategic Services Division he has worked to implement evidence-based practices, enhance crime analysis capacity, and develop tools to support the agency's community-oriented policing efforts. He has BS and MS degrees in Criminology from Portland State University, with additional training in Law Enforcement Planning and Intelligence Analysis. He is a member of the NIJ's Law Enforcement Advancing Data Science (LEADS) program.

Greg Stewart, MS, Lt., has worked for the Portland Police Bureau in Oregon since the mid-1990s. His assignments have included patrol, street crimes, domestic violence investigations, and currently he is the Captain overseeing the bureau's Advanced Training Academy. Captain Stewart helped create the PPB's centralized crime analysis unit and he participated in NIJ's LEAD scholar program. He is also an adjunct professor, research analyst, and MS graduate of Portland State University's Criminology and Criminal Justice Department.

Kimberly Kahn, Ph.D., is an Associate Professor of Social Psychology at Portland State University and leads the Gender, Race, and Sexual Prejudice (GRASP) research lab. She received her Ph.D. in Social Psychology from the University of California, Los Angeles. Dr. Kahn's expertise centers on how subtle stereotypes, implicit bias, and identity-related threats affect police behavior within the criminal justice domain. Partnering with police departments, Dr. Kahn has conducted extensive empirical research and interventions to reduce bias in police departments across California, Nevada, and Oregon. Her work has been funded by the National Science Foundation, the Society for the Psychological Study of Social Issues, the BJA, and the National Institute for Transportation and Communities.

Yves Labissiere, **Ph.D.,** is an Associate Professor of University Studies and the School of Public Health at Portland State University where he teaches undergraduate and graduate-level classes and conducts research on the psychology of oppression and empowerment, equity, inclusion, and inter and intra-group relations and conflict. His research focuses broadly on intra/intergroup relations and ethnic identity among immigrant and indigenous groups and more specifically on the negotiation of notions Blackness and racial and ethnic identities among groups categorized as Black in the US. The central theme of his research is to understand how race, identity, language, difference, power, and privilege play a role in education and health systems including developing strategies that build community trust, heal and empower individuals and transform systems.

Brian Renauer, Ph.D., is a Professor in the Department of Criminology and Criminal Justice and Director of the Criminal Justice Policy Research Institute at Portland State University. His recent research interests have centered on issues of racial/ethnic disparity and criminal justice within a variety of areas (e.g. public perceptions of trust/legitimacy, implicit bias, police stop and search decision-making, risk assessment, juvenile referrals to court, sentencing/plea-bargaining, and public transit fare enforcement). Dr. Renauer and his research team were awarded The W.E.B. Du Bois Scholars in Race and Crime Research FY 2017 from the NIJ for an examination of the pre-trial risk assessment approaches and sentencing outcomes in two Oregon counties.

Renée J. Mitchell, Ph.D., served in the Sacramento Police Department for twenty-two years and is currently a Senior Police Researcher with RTI International. She holds a B.S. in Psychology, a M.A. in Counseling Psychology, a M.B.A., a J.D., and a Ph.D. in Criminology from the University of Cambridge. She was a 2009/2010 Fulbright Police Research Fellow where completed research in the area of juvenile gang violence at the London Metropolitan Police Service. She is a co-founder of the American Society of Evidence-Based Policing. Her research areas include policing, evidence-based crime prevention, evaluation research and methods, place-based criminology, police/citizen communication and implicit bias training.

Sean Sothern, **Sgt.,** has worked in a variety of roles at the Portland Police Bureau since 2000.

Table 1. *Frequency of Patrols*

	# Patrols Total		# Patrols per Hot spot				
			Planned	Delivered			
Condition[a]	Planned	Delivered	#	Min	Max	*M*	*SD*
Control	0	0	0	0	0	0	0
2 CEPs per day	5,400	4,224	180	102	172	140.8	18.3
4 CEPs per day	10,800	8,741	360	230	331	291.4	24.1

[a]30 hot spots per group.

Table 2. *Average Patrol Dose per Hot Spot (minutes & seconds)*

	Planned	Delivered			
Condition[a]		Min	Max	*M*	*SD*
Control	0	0	0	0	0
2 CEPs per day	15:00	16:25	25:20	20:47	2:29
4 CEPs per day	15:00	17:40	24:31	20:56	1:31

[a]30 hot spots per group.

Table 3. *Patrol Dosages*

	# Hours Total		# Hours per Hot spot				
			Planned	Delivered			
Condition[a]	Planned	Delivered	#	Min	Max	*M*	*SD*
Control	0	0	0	0	0	0	0
2 CEPs per day	1,350	1,466	45	30.1	67.3	48.9	9.1
4 CEPs per day	2,700	3,061	90	67.9	125.5	102.1	14.0

[a]30 hot spots per group.

Table 3. *Patrol Dosages*

	Hours, total[b]		Hours, per hot spot				
	Planned	Delivered	Planned	Delivered No.			
Condition[a]	No.	No.	No.	Min	Max	*M*	*SD*
Control	0	0	0	0	0	0	0
2 CEPs/day	1,350	1,466	45	30.1	67.3	48.9	9.1
4 CEPs/day	2,700	3,061	90	67.9	125.5	102.1	14.0

[a]30 hot spots per condition.

[b]Represents the total number of CEPs across the 30 hot spots within each condition.

Figure 1

Distribution of Completed CEPs and Offenses (2012-13) by Time of Day and Day of Week

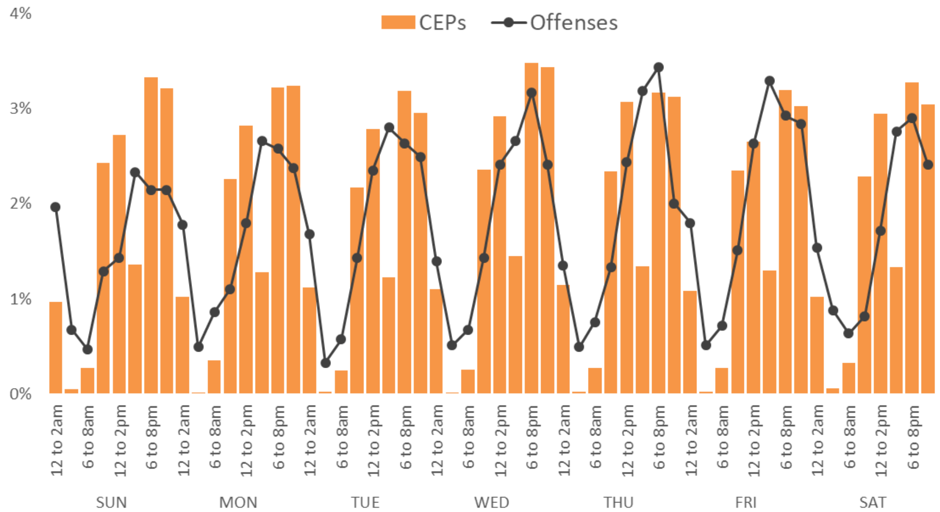
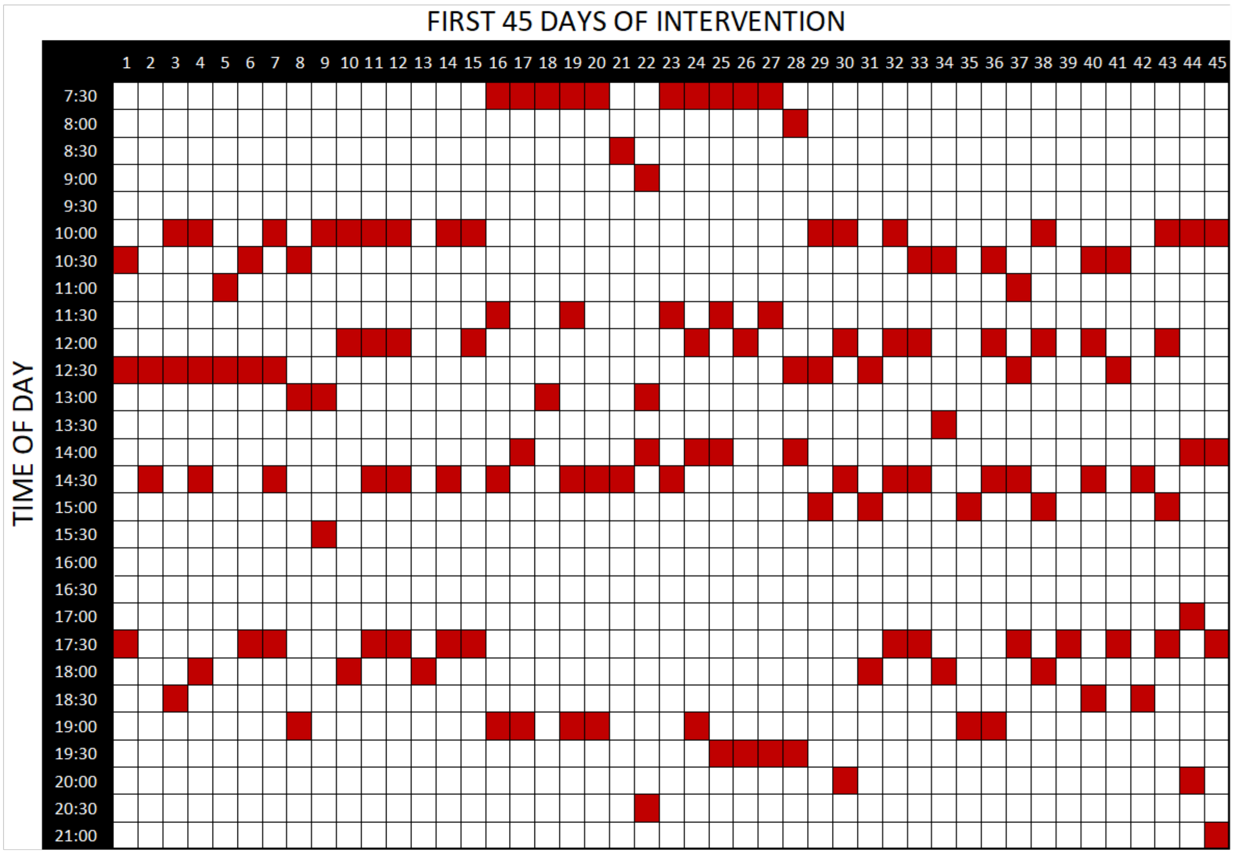


Figure 2.

Variability in Officer's Arrival Time in Hot Spot #42



Note: Red squares represent the arrival time (on scene) for completed community engagement patrols (CEPs) in Hot Spot #42 assigned to the four patrols per day condition.