Shift Structure and Cognitive Depletion: Evidence from Police Officers

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Abstract: Decision-making, risk-taking, and situational awareness are all important factors for effective and equitable policing. However, these factors can also be affected by fatigue, overwork, and cognitive stress, which can accumulate as police officers continue to work. This paper studies how working consecutive days affects police officer outcomes and decision-making using rich data from the Chicago Police Department. To deal with potential selection of working days, I leverage arbitrarily-assigned fixed schedules as well as a two-way fixed effects design that uses both within-officer and within-assignment variation. I find that, after initially increasing, officers make fewer arrests, conduct fewer stops, patrol less, and are more likely to be injured as they work more days. The declines in activity are driven by reductions towards the end of an officer's shift. Fatigue, inexperience, and cognitive stress all contribute as mechanisms for a reduction in activity with several alternative mechanisms explored. Despite this decline in arrests and activity, officers file more use-of-force reports after working many consecutive days.

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1 Introduction

Professions of every kind encompass a unique blend of demands, from physical exertions and mental challenges to the need for attention, coordination, and the integration of new information. Each job, whether in construction or academia, relies on workers facing these cognitive challenges, which can intensify and compound during extended work periods. How do these prolonged hours and consecutive workdays affect workers' performance, particularly in high-stakes professions such as law enforcement? This central question informs the need for optimal shift design and programs combatting officer fatigue to maintain workplace effectiveness and safeguard the health and safety of workers and the public.

Police officers, in particular, face substantial physical and cognitive demands; their extended shifts necessitate making frequent split-second, life-and-death decisions. For instance, police officers must swiftly determine the appropriate level of force to use in potentially harmful situations, with choices ranging from deploying a firearm to opting to withdraw. Additionally, these choices are frequently based on profiling or instinctive judgment making them especially prone to being influenced by increased cognitive load. Prolonged work periods may significantly affect a police officer's decision-making, potentially leading to poorer judgment, more forceful interventions, or changes in productivity. However, at the core of the issue is a lack of knowledge about how different shift structures affect the quality of police officer performance, which has brought this topic to the forefront of policy debate.

Despite shift design is a critical determinant of workplace effectiveness, the optimal balance between workdays and breaks is often unclear. Work schedules vary greatly, both in their duration of shifts and their patterns of workdays and non-workdays. Working consecutive days has benefits. For example, time off may interrupt a worker's accumulation of skill and experience and can lead to substantial start up costs (Erosa et al., 2017; Eden, 2021). However, long shift work has been associated with, lowered productivity (Pencavel, 2015; Collewet and Sauermann, 2017; Bavafa and Jónasson, 2023), increased on-the-job mistakes (Brachet et al., 2012), poor mental health (Zhang et al., 2018), lower reaction time, and poor driving skills (Huffmyer et al., 2016), and burnout (Kant et al., 2003). Importantly, the specific threshold at which work becomes "too much", triggering these negative effects, is often undefined and varies by individual and context making shift design a difficult endeavor.

This paper leverages variation in police shift structures to explore how cognitive stress and fatigue affects police officer behavior. I utilize a vast amount of rich data from the Chicago Police Department on individual personnel decisions and police officer outcomes between 2014 and 2020. Several key performance indicators are explored such as arrests made, use-of-force reported, and investigatory stops conducted. Additionally, I explore discretionary arrests as a measure of police officer frustration and escalation to build on RCT findings from Dube et al. (2023). Lastly, I explore the incidence of officer and civilian injury as well as heterogeneity by officer and civilian characteristics to identify how racial prejudice and bias can be exacerbated by cognitive stress and fatigue.

To overcome the endogenous selection of working days, I exploit a unique shift structure common among police officers, where working days are predetermined and based on fixed groupings. Because of the rigid structure and pre-determined nature of these shifts, I can explore the relationship between officer outcomes and shift structure, independent of crime levels on each day. The key identifying assumption is that officers cannot control the days that they are working to strategically work on days with higher or lower levels of crime. In this setting, officers are assigned to work four consecutive 9-hour working days and have this schedule fixed for the entire year. These comparisons help to understand the dynamic effectiveness of officers between successive days and can help motivate policy decisions about how shifts are assigned.

This paper finds that initially, officers make more arrests, conduct more stops, and report using more force as they work more. Specifically, there is an approximate 6% increase these activities from an officer's first to their second day. This relationship stabilizes, and activities remain consistent between the second and third days, except for use-of-force. In fact, officers increase the amount of total force used by 11% when compared to their first day. By the fourth day, both arrests made and stops conducted decline to at or below their baseline levels. However, use-of-force remains elevated, with a total of a 10% increase on an officer's fourth day.

That is, despite a large decline in arrests, officers file more use-of-force reports after working 4 consecutive days. This result is important for two reasons. First, an increase in force is a costly outcome and understanding why officers use force in one instance but not another is itself an interesting question. Secondly, this pattern helps dispel the notion that a reduction in arrests is entirely due to a decrease in policing effort. Rather, it indicates that officers may not be reducing their overall policing effort but are instead becoming more physical and potentially more harmful as they work more shifts. Prior work has found that sleep disruption and fatigue are associated with increased aggression (Van Veen et al., 2022) and increased risk-taking (Salfi et al., 2020), potential mechanisms for a rise in use of force.

In addition to using more force, I find evidence of frustration and fatigue as working days increase. There is a notable rise in discretionary arrests—for offenses such as disobeying an officer—which suggests an escalation in officers' frustration and a diminished capacity to de-escalate situations. Moreover, there is evidence of shirking, as indicated by longer response times to 911 calls and a decline in patrolling activity, evidenced by reduced GPS activity of patrol cars. Lastly, officers are more likely to injure themselves by their fourth day.

These trends are driven by a combination of factors that affect the mental and physical endurance of police officers. The depletion of cognitive endurance threatens an officer's capacity to maintain focused mental activity over a continuous stretch of time (Brown et al., 2022). Fatigue, compounded stress, lack of sleep or rest, exposure to trauma, and threat of bodily injury are all potential mechanisms that have both real impacts on officer health and are likely to impair police officers. The depletion of cognitive endurance can lead to automatic and more intuitive decision-making, rather than higher-quality and more carefully considered responses (Caplin and Martin, 2016), an increased preference for risk (Castillo et al., 2017), increased temptations for alcohol, poor eating habits, and risky health behaviors, which each can contribute to myopia, poor self-control, and interfere many forward-looking decision processes (Schilbach, 2019), and sleep imbalances, which have been shown to cause errors in judgment, impatience, and less efficient processing of information (Kamstra et al., 2000). Additionally, there is evidence that police officers are cognitively constrained, and have potential to improve their relationship with their communities if their cognitive resources are effectively managed (Dube et al., 2023).

This paper contributes to prior work in several areas. This paper advances the understanding of how shift structure influences productivity and cognitive load. Prior work has explored non-law enforcement occupations and found that prolonged hours can reduce effort (Chan, 2018), increase mistakes (Brachet et al., 2012; Huffmyer et al., 2016), and reduce efficiency (Bavafa and Jónasson, 2023). While prior work has predominately focused on the *negative* effects of working hours, several studies have suggested that consecutive working periods have *positive* returns to productivity in moderation (Erosa et al., 2017; Eden, 2021). Research of shift structure is limited by the fact that shift organization may have drastically different effects depending on occupation and has been limited on its applications to police officers.

Second, this paper contributes to understanding the cognitive load that police officers face. Recent work by Dube et al. (2023) illustrate that enhancing officers' decision-making capabilities while under cognitive stress has a potential to reduce adverse incidents. If factors such as fatigue and overwork could exacerbate the cognitive load on officers, then finding avenues to reduce this type of stress could improve quality of decision-making in high-pressure scenarios. This concern is underscored by surveys of police officers that have revealed that more than half of officers receive fewer than 6.5 hours of sleep and often score poorly on exams related to fatigue-induced impairment (Vila, 2000). Similar to Dube et al. (2023), I find that use-of-force and discretionary arrests are a margin that are affected by a police officer's cognitive load. However, opposite from Dube et al. (2023), I explore an environment where officers are put under increasing stress.

Lastly, this paper contributes to work on the economics of policing. This paper is related to Chalfin and Goncalves (2020), that demonstrates that police officers are motivated by a complex mix of intrinsic motivations and extrinsic incentives that are not well understood and difficult to alter. This paper provides further evidence that the quality of service that individual police officers provide is dynamic. However, this dynamic quality is difficult to maneuver. Previous studies have revealed that the options available to police managers, from a personnel perspective, "have been only rarely shown to alter police behavior in the field" (Owens and Ba, 2021). This paper provides new evidence of a powerful policy tool available to policing managers. The arrangement of shifts and geographical assignments remains an under-explored area, yet wields significant influence in the hands of police managers (Ba et al., 2021). Additionally, police departments have a wide range of shift structures with varying shift length, working days per week, and patterns of time off. Changes to police shifts has often been a contentious issue between police unions and government institutions (Spielman and Charles, 2019; NBC, 2022). Given the wide array of differences in shift structure both between and within departments, this paper helps to motivate policy design and optimal shift structures for policing and other related fields that require long hours and have high costs of making mistakes, such as health-care .

The rest of the paper proceeds as follows, Section 2 provides background on related literature and the shift structures of police officers in Chicago, Section 3 details the data and the empirical strategy, Section 4 gives the results on arrests, investigatory stops, and use of force reports, then conducts heterogeneity analysis, mechanism exploration, and robustness. Section 5 concludes with potential areas for future work.

2 Background

2.1 Motivation and Prior Literature

One of the principal inputs into the production of goods is labor. Measured in hours worked or workers employed, labor and production are positively related, where more hours worked is generally thought to result in higher production. However, the concave nature of labor as an input adds complexity to determining the ideal amount of labor for maximizing production, as the returns from adding a unit of labor can vary depending on when it is added. For example, Pencavel (2015) finds that munitions workers productivity and hours worked have a linear relationship until a certain threshold. After 48 hours worked within a week span, munitions workers showed a decline in productivity per hour. As a result, estimating the relationship between labor supplied and productivity is highly relevant to understanding optimal allocation of labor, profit maximization, and occupational safety.

There are several challenges when separating the effect of shift structure from individual ability due to potential endogeneity in how shifts are assigned. For instance, workers may be selected to work additional days because they are more capable of doing so. Additionally, for most workers who work on weekdays only, it is difficult to separate the effect of individual weekdays (say, Friday) and interactions between coworkers, whose work schedules are correlated.

To combat endogeneity Collewet and Sauermann (2017) use data from call center workers, who are scheduled from a centralized personnel manager independent of worker preferences. They find that a 1% increase in working hours translates to a 0.9% increase call volume (a measure of output). This reduction in measured output is accompanied by an increase in call quality, a potential benefit of continuity of work. The approach for the current study is similar in that it leverages a centralized planner and uses individual-level data, but differs in its setting.

The majority of prior work that relates working hours and productivity has focused on variation in hours worked within a day (intensive margin increase). The most common setting for studies of this type focus on medical professionals, who are often asked to work greater than 12 hours in a day. For example, Brachet et al. (2012) find that EMS workers have reduced performance at the end of long shifts (e.g. 24-hour shifts). This reduced performance is measured in slower response time to incidents, slower time per procedure, and increased pre-hospital interventions performed per patient. Similar to medical professionals, police officers make many choices throughout their shifts, where a mistake can be highly costly and cause great bodily harm. This paper aims to extend the results of Brachet et al. (2012), but in a new environment, policing, and leveraging both variation in number of shifts and the number of hours.

Firms and managers are not oblivious to the potential that increased work hours could hurt productivity and safety. In 2011, the Accreditation Council for Graduate Medical Education recommended a cap on the hours that medical interns can work, citing the potential for unsafe working conditions (Nasca et al., 2010). Similarly, FAA traffic controllers are restricted to 6 consecutive days and a maximum of 10 consecutive hours following a report that controllers were working five 8-hour shifts over a 4-day period. Additionally, police unions and municipal governments often have disagreements about how many hours and shifts officers are required to work. In Chicago, the leader of Chicago Fraternal Order of Police claimed, “cops are burnt out, they are not getting that needed time off, and they absolutely don’t have enough support from this mayor or superintendent”. This statement has been challenged by the then-Mayor Lightfoot, saying “This notion ... ‘They’re being worked like mules' — it's just simply not correct," (Pratt, 2022).

2.2 Police Shift Structures

The total direct and indirect costs of crime are estimated to be $3 trillion per year in the United States (Anderson, 2021). The principal organization responsible for reduction and deterrence of crime, the police, are comprised of 800,000 sworn law enforcement officers spread over approximately 18,000 agencies (NLEOMF, 2023). Despite similar goals, these police departments in the United States are decentralized with varying personnel structures, incentive schemes, and training. Little is known about how these differing personnel structures lead to differing effectiveness of police departments. This is especially important considering that in recent years, police forces have had trouble recruiting new officers and retaining current officers with declines in total officers during 2022 in the three largest police departments, New York City, Chicago, and Los Angeles (NY DCJS, 2023; Federation, 2022; Times, 2021).

Generally, prior work has found a negative elasticity of crime with respect to the number of police in an area. (Weisburst, 2019; Mello, 2019; Fu and Wolpin, 2018; Draca et al., 2011; Evans and Owens, 2007; Di Tella and Schargrodsky, 2004; McCrary, 2002; Levitt, 1997) These studies explore how the quantity of officers effects crime levels. An interesting extension to this idea is to explore the relationship between quality and quantity of police officers. This is especially important given heavy social cost that policing has on heavily-policied, often minority, communities (Ang, 2021).

Working numerous consecutive shifts might impact an officer's performance, with unclear outcomes on their productivity. Officers on successive days may improve their abilities in solving and preventing crimes due to increased understanding of local crime patterns and community dynamics. This knowledge enables more effective surveillance and swift action on investigative leads. However, the transition between personal and professional mindsets could introduce significant start-up costs, particularly in high-crime zones, potentially affecting the overall quality of an officer's work.

While there may be benefits to working consecutive shifts, the potential risks associated with such schedules could be quite costly. Prolonged periods of work without adequate rest can lead to fatigue and exhaustion among officers, diminishing their physical and mental health. In situations where empathy and patient negotiation are crucial, an overworked officer may be more prone to errors and resort to depersonalized policing, prioritizing swift resolutions over deescalation tactics. The cumulative effect of fatigue can impair judgment and reduce the capacity for nuanced decision-making. Ensuring fatigue is not a factor in fair and equitable policing is pivotal in maintaining public trust and ensuring the safety of both officers and the communities they serve.

Police officers are also an interesting context to study shift structure because of the combination of a wide range of shift structures employed. Research on how shift structure affects police has left many unanswered questions and has been limited in its scope. This dearth of applied research is exacerbated by the highly decentralized nature of police forces where US police departments have a wide array of variation in how the assign shifts, the number of hours worked in a day, and the organization of days worked within a week.

3 Data and Methodology

Data for this paper comes from multiple Freedom of Information Act (FOIA) requests filed with the City of Chicago and the Chicago Police Department. These data help to understand officer duty schedules and daily activities, providing insight into the operational behaviors of police personnel.

3.1 Shift Logs

The primary source of data for this study are the shifts worked by members of the Chicago Police Department (CPD) from 2014 through the end of 2020. This dataset includes detailed records of over 15,000 sworn officers and nearly 13 million shifts. For each officer, the data includes key demographic and professional information such as name, badge number, race, age, and tenure, as well as records of any work absences and their reasons. Additionally, the data specifies the watch (time of day) and beat (geographic location) to which officers were assigned. Beats in Chicago are geographic areas covering approximately one square mile. Officers that are explored in this paper will be tasked with patrolling their assigned beat and will typically not respond to calls for service outside of this assigned area. There also includes a rough measure of the specific assignment within each beat. There are over 9,000 unique combinations of beat, watch, and assignment recorded in the dataset, which together define the specific roles and responsibilities assigned to each officer.

Officers will work similar watch and beat-assignments day to day. These assignments are given out at the beginning of each year and are decided based on a seniority-based preference system (more tenured officers pick first) and the discretion of a watch commander. While assignments generally do not change, the watch commander has the power to move officers to new assignments based on the operational needs of their respective districts. Because these are set at the beginning of each year, officers have little power to manipulate their schedules on a day-to-day basis.

The structure of shifts for CPD officers is, in large part, structured based on 'day off groups', a scheduling system where officers are designated into 6 distinct groupings that dictate which days officer are assigned. All officers within the same 'day off group' are assigned to work on the same days. This structure leads officers to have their set of workdays and off-days to be predetermined and rotating. Officers in this study will work for 4 consecutive days followed by 2 days off. Because this is a 6-day schedule (rather than a typical 7-day schedule), officers will work weekdays in a rotating fashion. For example, an officer may work Monday to Thursday, followed by Sunday to Wednesday, followed by Saturday to Tuesday.

Importantly, each 'day off group' is staggered by one day. That is, on any given day each 'day off group' is at a different stage of their rotating schedule. An example of this structure is illustrated in Figure 1 for two of these day off groups. This structure assures that both weekend and weekdays are evenly distributed to officers, and that officer are evenly distributed between days of the year. This scheduling is advantageous to a researcher, since it removes some of the selection that workers have to choose their working days based on crime levels. While deviations from this schedule do occur they are treated as anomalies in the analysis. Figure 1 shows that these deviations are relatively rare, in fact, fewer than 2% of shifts fall outside an officer's assigned days.

3.2 Measures of Police Officer Activity

Several outcomes are used to explore the actions of officers, all coming from the CPD and matched to officers by their name, birth year, and hiring date. First, arrest records by officer are added for all non-juvenile arrests made between 2014 and 2020. This data includes the demographics of arestees (race, age), and suspected crime. This data also includes the role of each officer in each arrest from first officer, second officer, or assisting officer. Each arrest requires one first officer but may also contain one second officer as well as any number of assisting officers. The majority of analysis utilizes counts of arrests of any role. But the patterns in outcomes are consistent between alternative definitions and analysis using only specific roles are provided in the Appendix Figure A.6.

Second, investigatory stop records are included. These data record incidents where a CPD officer stops and questions a civilian based on suspicion that the civilian has committed a crime. For each stop, this data contains demographic information on the stopped individual (race, age) and information on at least one one first officer and an optional second officer. Similar to arrests, the counts of stops that are used do not restrict to specific roles. Alternative analysis using only specific roles are provided in Appendix Figure A.7. Investigatory are available from 2016 to 2020.

Third, the number of parking tickets, traffic violations, and citations are included. Each of these measures has only one officer listed. This data measures a lower level of enforcement compared to arrests. These outcomes are summed together for the majority of analysis, but they are presented individually in Appendix Figure A.9.

Lastly, officer 911 dispatch data is included for all 911 calls for service between 2014 and 2020. This data includes several time segments that measure each officers daily response time to their assigned calls for service. All calls originate from a civilian and are entered into a centralized dispatch system. Once a dispatcher records the manner of emergency and the location of the call, they will assign an officer to be dispatched. In most cases calls for service are assigned to officers within their beat. In this paper, dispatch time is split into three separate time segments: (1) the time from the initial 911 call to when the dispatcher assigns an officer to respond, (2) the time from an officer is assigned to when they report being en route to the call location, and (3) the time from when an officer is en route to when they arrive on-scene. Each of these time segments measure a different aspect of call response. Segment (1) is a placebo test of sorts, as it measures dispatcher availability, not officer response. Measures (2) and (3) measure officer response. Measure (2) measures the availability and alertness of officers, while measure (3) measures officer's driving and proximity to call location.

Summary statistics for each of these measures of officer activity are presented in Table 1.

3.3 TRR Use-of-Force Reports

Following an instance of force, CPD members will file a Tactical Response Reports (TRR) detailing the circumstances that resulted in force being used. According to CPD policy, a TRR must be filed if a civilian alleges injury due to officer actions or the civilian actively resists, flees, uses force against an officer, or physically obstructs an officer (CPD, 2020). The filing of a TRR automatically triggers a review and approval process by an officer's supervisor, a process that is usually completed within 20 minutes of the event. For this analysis, I use all TRR reports filed for over the years 2014 to 2020 for non-juvenile suspects. In total, there are 33,811 TRR reports filed during the sample period. For my analysis, I use total force reported, measured in the number of force actions recorded on a TRR report. On average there are 2.7 force actions recorded per TRR report. While this measure is preferred, as it captures the intensity of force, the results with each outcome are indistinguishable from one another and are shown in Appendix Figure A.8.

3.4 Sample Restrictions

This paper makes three sample restrictions to obtain a subset of shifts where officers can be appropriately compared. Since the CPD is a large organization with many levels of ranks, tasks, and schedules, these restrictions reduce the amount of variation that arises from endogenous differences in officers and shift types to help isolate the treatment effect of consecutive days worked.

First, this paper uses officers who are assigned to work watch 1 (night), watch 2 (morning), or watch 3 (evening). These three watches make up 82% of officers and are the standard watches for beat officers. A 4th watch is reserved for special assignments that can start at any time of the day and is not used for this analysis.

Second, this paper uses police officers who are assigned to day off groups 61 through 66. These groups are the largest day off groups and entirely contain officers who work 9-hour shifts, the most common shift length for CPD officers. These 6 day off groups account for 86% of all district-assigned officers who work watch 1 to 3 and represent the 'standard' groups for CPD patrol officers.

Third, shift spells (a string of consecutive workdays) that extend beyond 4 days are excluded from the analysis. Both these additional shifts and the shifts leading up to these extra days are excluded making all shift spells in this analysis 4 or fewer days. These removed shifts, which account for 4% of all shifts, are considered abnormal because they represent officers working outside their assigned days. This would lead to a different relationship between days worked and officer effort, as officers may reduce their effort over their entire shift spell when faced with additional scheduled days. These extra days often occur during periods of increased demand for officers and as a result, for the main analysis, should not be compared to when increased police presence is not needed. The temporal variation of these extra days are shown in Appendix Figure A.13, which shows that these extra days occur during high-crime summer months.

3.5 Methodology

To explore the relationship between consecutive days works and police officer outcomes I estimate the following two-way fixed effects Poisson model:

$$\begin{aligned} ln(y_{it}) = &\delta_2 \times \mathbb{I}(\text{DayWorkedNumber}(2)_{it}) \\ &+ \delta_3 \times \mathbb{I}(\text{DayWorkedNumber}(3)_{it}) \\ &+ \delta_4 \times \mathbb{I}(\text{DayWorkedNumber}(4)_{it}) + \theta_i + \tau_t + \beta_a + \varepsilon_{it} \end{aligned} \tag{1}$$

Where y_{it} are various outcomes for officer i on date t. Outcomes are counts of actions, such as total arrests, or stops conducted; all at the officer-date level. The main parameters of interest are δ_2, δ_3, and δ_4. These coefficients measure the relationship between the set of indicators, $\mathbb{I}(\text{DayWorkedNumber(n)}_{it})$, which are indicator variables that is equal to 1 on an officer's n^{th} day worked, and the outcomes y_{it}. Due to the sample restrictions mentioned in Section 3.4, which restrict shifts spells of length 4, the maximum value for $\text{DayWorkedNumber}_{it}$ is 4. The indicator for the first shift worked is omitted so that all estimates are relative to the first shift. In total, 3 indicator variables are included for days two, three, and four. This specification allows for a non-linear relationship between each of the consecutive days worked and various officer outcomes.

Also included are officer fixed effects (θ_i), date fixed effects (τ_t), and beat-assignment fixed effects (β_a). There are a total of 10,073 unique combinations of beat and assignment included. The addition of beat-assignment fixed effects, indexed by assignment a, helps to account for potential endogenous assignment of officers based on their shift history. However, there is little evidence that this occurs. In fact, the estimates of δ_2, δ_3, and δ_4 are not sensitive to the inclusion of beat-assignment fixed effects, further evidence that beat-assignments and the number of consecutive days worked are not correlated. Lastly, Standard errors are clustered at the officer level.

Identification in this model comes from the arbitrary assignment of shifts to officers through the centralized 'day off group' scheduling system discussed in Section 3.1. While the assignment of shifts is not strictly random, this system significantly constrains individual officers from manipulating which days that they work. Once an officer is given a beat (location) and watch (time of day) assignment, the officer will typically work that same post for one year or more. While an officer may have a preference for a day off group because it gives them a specific day off in the year (e.g. a birthday), they will be restricted to that day off group for the rest of the year.

Due to this scheduling structure, $\text{DayWorkedNumber(n)}_{it}$ can be seen as exogenously assigned to officers and independent of daily-level trends in crime. Fixed effects for officer and date are included in Equation 1 to control for time-invariant officer characteristics and time-variant changes across Chicago. And, as will be shown in Section 4.8, a model without fixed effects yields similar results to the model with fixed effects, bolstering the claim that individual shift assignments are not based on officer-specific or date-specific factors.

4 Results

4.1 Main Results

Figure 2 displays the key estimated coefficients from Equation 1 on the following outcomes: Total Arrests Made, Total Stops Conducted, and Total Force Reported, each separately. Each estimate compares one of the three main outcomes between an officer's first day and their second, third, or fourth day. The y-axis gives these point estimates derived from a Poisson regression. The baseline values of each outcome variable is shown in Table 1.

Between days one and two, police officers increase the amount of stops conducted (in blue) and the total arrests made (in green), both significant at a 95% level. This increase in activity can be attributed to a combination of factors, such as a warm-up period while an officer gets acclimated to police work, or a more structural change in police work, such as a longer briefing period after a break in work. After three days working, police officers decrease both the amount of stops conducted and the total arrests made, returning to their day one levels. This finding suggests that officers are more vigilant and proactive in the middle of their work cycle. Conversely, the decrease after day three might be attributed to accumulated fatigue, leading to reduced productivity or a strategic conservation of energy as officers anticipate the end of their work period. This U-shaped curve is consistent between both of these outcomes, rising between 5 and 7% before falling.

Use-of-force, on the other hand, does not see a reduction and continues to rise as an officer works more. Police officers file more use-of-force for each of the first three days worked. This level is maintained for the fourth day at approximately 10% above its day one level.

The divergence in trends between arrests and force suggests less efficient policing, rather than a reduction in effort. It is important to note that the nature of a police officer's job inherently involves force, and an increase in force is not necessarily a cause for concern. Without further analysis it is difficult to say whether an increase in all policing activity is a welfare improving or reducing behavior. However, because force increases without a corresponding rise in arrests or stops, it may indicate the use of potentially unnecessary or excessive force.

These findings have important implications for law enforcement scheduling policies. If the observed decrease in stops and arrests after three days is indeed driven by fatigue, it may be beneficial for police departments to consider alternative scheduling approaches. Rotating shifts more frequently or incorporating mandatory rest periods to maintain officer effectiveness are some potential solutions. The benefits to more rest are especially relevant if an increase in use-of-force is due to a decline in cognitive functioning and officer health. Quick decision-making in high-stress situations can lead to escalation and confrontation, which is problematic if officers are already frustrated or aggressive. The following sections dive deeper into how police officers change their actions and decision-making processes and explore more deeply into the trade-offs that officers face. Characterizing the dynamic effectiveness of officers is important for policy design, public safety, and officer health.

4.2 Shifts in Arrest Patterns and Discretionary Actions

A key question arising from the finding that officer activities change over consecutive workdays is whether police officers are encountering different environments or adjusting their reactions to similar situations. To explore this idea, this section delves into the types of arrests that officers make. To do so, I estimate Equation 1 using counts of arrests by arrest type as the outcome.

Table 2 explores the types of arrests that officers make as they work additional shifts and finds that officers do not change their main arrest types but do make more discretionary arrests as they work more consecutive days. In Columns (1) and (2) I split arrests based whether they are considered 'discretionary' following Dube et al. (2023).[1] Discretionary arrests are arrests for actions such as disobeying an officer or disorderly conduct. These arrests can stem from an emotional response or a failure to de-escalate rather than ones backed by objective evidence (Dube et al., 2023). The decision to charge a civilian with a discretionary arrest, while based on real actions, is often left up to the officer.

In Column (1) we see that discretionary arrests, linked to officer frustration and emotional fatigue, remain elevated on an officer's final day. Similar to use-of-force, the divergence of discretionary arrests from non-discretionary arrests illustrates how consecutive days worked can contribute to emotional responses from officers. The patterns of discretionary arrests are similar to that of use-of-force, suggesting that they are driven by similar frustration-based mechanisms. This result follows similar findings as Dube et al. (2023), who find that cognitive-based training that emphasizes thoughtful decision-making reduces officer discretionary arrests, use-of-force, and officer injury. The findings of this paper are consistent with that result. I find that when officers are cognitively constrained (due to consecutive working days), these same outcomes are affected.

In Columns (3) to (8), I explore arrests by the charge type but find little difference between them. The purpose of this analysis is to see if officers make trade-offs between arrest types as they work more. For all charge types, a familiar U-shaped curve is present where officers increase their outcomes initially before declining.

[1]The specific definition of this variable is given in Dube et al. (2023) Table A2.

This analysis helps to rule out that changes in the main outcomes are not driven by a structural change in the nature of police work between days. For example, an officer could decide to fulfill arrest warrants or monitor traffic on their final day. We do not see this, as the relationship between days worked and arrest types is consistent between types of arrests. Since arrest patterns are similar between arrest types, it is unlikely that the patterns observed are due to a preference for specific types of arrests on a specific day. Rather, they are driven by an overall change that affects arrests equally.

In summary, police officers do not change the types of arrests that they are involved in as they work more consecutive days. However, they show signs of frustration and aggression, as they increase the amount of discretionary arrests that they make. This result follows conclusions from Dube et al. (2023), that cognitively-constrained fatigued officers are more susceptible to behavioral changes in how they police.

4.3 Officer and Civilian Injury

If officers are using more force for the same incidents, it is natural to think that they are more likely to injure themselves and others. Civilian injuries resulting from police actions are significantly costly events, impacting both the individuals involved and the city, should the injury lead to legal action. Officer injuries can exacerbate issues related to under-staffing, as officers would need time to recover. To investigate this idea, I estimate Equation 1 using the count of TRR force reports that include a report of injury to officers or to civilians.

Column 1 of Table 3 presents estimates for police officer injury. I find no significant difference in injuries reported to officers for the first three consecutive days worked. However, by the fourth day, there is a substantial increase in reported injuries. This surge in injury prevalence coincides with the observed divergence between use-of-force and the number of arrests made.

Civilian injury does not see a significant increase, yet there is suggestive evidence of an elevated threat. Given the imprecision of these estimates, ruling out effect sizes for this issue is challenging. Additionally, injuries reported by officers themselves are likely to be more reliably documented compared to officer-reported injuries to civilians.

4.4 Heterogeneity by Race/Ethnicity and Tenure

This section examines the impact of shift structure on outcomes differentiated by civilian race/ethnicity and officer tenure. Table 4 presents results based on the race/ethnicity of each civilian involved for three outcomes: arrests (Panel A), stops (Panel B), and use-of-force (Panel C). The initial increase in stops is driven by changes in stops of black and Hispanic civilians. Conversely, the number of stops involving White civilians remains relatively stable across different days. This difference in stop rates is important, as variations in police presence across racial and ethnic groups may lead to disproportionately higher arrest rates for more heavily policed communities, irrespective of the actual level of criminal activity (Chen et al., 2023).

Interestingly, while stops conducted are higher for black and Hispanic civilians, this trend of increased activity involving black and Hispanic civilians is not seen in arrests. For arrests, civilians of each race/ethnicity experience an initial increase followed by a decrease. One potential reason for this discrepancy is that investigatory stops could be motivated by racially-biased profiling. Investigatory stops are often based on cognitive factors such as intuition and deduction rather than objective evidence or first-hand observation, like many arrests.

Use-of-force is reported by the race/ethnicity of civilians in Panel C but should be interpreted with caution. Given that a use-of-force incident is a relatively rare event and 77% of use-of-force incidents involve black civilians, the statistical power to detect differences among other racial or ethnic groups is limited.

Lastly, Table 5 presents the results by officer tenure. Overall, more experienced officers (20 or more years experience) exhibit less variability in their outcomes. In fact, other than one significant estimate, experienced officers show no relationship between days worked and daily outcomes. This offers evidence that variation in these outcomes can be reduced with experience as experienced officers appear to be more able to provide a consistent service. However, it should be noted that experienced officers make fewer arrests than mid-career officers. It is important to recognize that these findings might represent an upper limit on the benefits of experience, conflating the effects of both expertise and fatigue.

4.5 Dispatch and Patrolling Behavior

In this section I explore how working consecutive days affects officer dispatch and patrolling behavior. While arrest behavior reflects officer decision-making in the field, these decisions are influenced by prior activities such as patrolling and dispatching to calls for service. Given that police dispatches are one of the most frequent interactions between the police and the public, they are crucial for understanding effectiveness and public perception of police. Analyzing how officers change their patrolling and dispatch behavior can help provide insight into the types of crimes they observe and how capable they are to make arrests.

Dispatch time refers to the duration from when a civilian calls 911 to when an officer to arrives on-scene. This is split into three segments: (1) the time from the initial 911 call to when a centralized dispatcher assigns an officer to respond, (2) the time from an officer is assigned to when they report being en route to the call location, and (3) the time from when an officer is en route to when they arrive on-scene. In most circumstances, officers are only assigned to respond to 911 calls within their beat.

Table 7 examines the relationship between consecutive days worked and police officer dispatch time, revealing that while officers do not change their overall dispatch time, the take longer to repond to dispatch orders on their fourth day worked. Column (1) reports the full dispatch time while Columns (2) to (4) breaks down dispatch time into the three aforementioned segments. I find no significant change in overall dispatch time in Column (1). Column (2) serves as a placebo test, as it reflects dispatcher availability, which would only be affected if consecutive officer days were correlated with dispatcher availability, such as through low- or high-crime days. In Column (3), there is a small but significant increase in dispatch-to-enroute time for officers on their fourth day. This dispatch segment reflects and officer's response time to dispatch orders and can be delayed if an officer is unprepared or slow to respond to dispatch orders. Once an officer is enroute to a crime scene, I find not change in their response time, reported in Column (4).

Next I use data from CPD patrol car GPS pings, which record the longitude, latitude, and speed of CPD patrol cars when they exceed 15MPH. These pings will register at most once every 30 minutes. This data will help understand officer patrolling and mobility patterns by detecting how often officers are stationary versus active patrolling.

Figure 4 presents an analysis of the relationship between consecutive days worked and GPS ping data, revealing that officers exhibit fewer movements as they work more consecutive days. This can be seen on the left panel, where I find small, but significant reductions in total GPS pings, indicating decreased geographic activity from officers as they work more. Notably, on an officer's last day, GPS pings see the largest decline, which coincides with the drop in total arrests made and stops conducted, as seen in Section 4.1. These patterns suggest various potential mechanisms, such as reduced patrolling, substituting driving with walking, or spending more time with each arrest. However, without knowing the specific reasons for officer movements, pinpointing the exact mechanism of reduced patrolling is challenging. That said, even without pinpointing the specific mechanism, reduced patrolling is a potential mechanism for the decline in other policing activities, such as total arrests made.

Lastly, in the right panel, I find that officers only slightly increase their speed as their consecutive working days increase. This change is small and precise, totaling a 0.4% change over all working days and can be considered a null finding due to its small size.

4.6 Within-Shift Changes

This section analyzes within-shift changes in officer behavior, focusing on how patterns of activity and decision-making evolve throughout a shift and across consecutive workdays. For this analysis, only shifts lasting exactly 9-hours in length are included. This is the standard shift length and accounts for 98% of shifts in the main estimation sample. These 9-hour shifts are divided into 3-hour segments and then the first, middle, and final segment are each estimated separately. This approach allows for comparisons between the first 3 hours of an officers initial shift with the first 3 hours of an officer's n^{th} shift as well as similar comparisons for the middle and final 3-hour segments.

The goal of this analysis is to explore how an officer's actions evolve within a shift and how that relationship changes as they work more days. The effects of fatigue would be most pronounced at the end of an officer's shift, when they face the combined strain of consecutive days and consecutive hours within a day.

Indeed, across both arrests made and stops conducted, the final 3 hours of an officers final day exhibit the lowest relative levels compared to any 3-hour window. However, officers still have a familiar U-shaped relationship between consecutive days worked and these outcomes. This finding is important, because it indicates that officer's face the compounded effects of fatigue-like mechanisms, both within a shift and between days.

While use-of-force also declines in the final 3 hours, the reduction is far less pronounced. Across the first and middle 3 hours segments, officers are increasing their level of force between days. That is, even within the first three hours of an officer's shift, they use more force as they work more consecutive days.

Taken together, the reduction in arrests made and stops conducted at the beginning an officer's fourth day combined with the increase level of use-of-force at the same time, suggest that the divergence in these outcomes is driven by the compounding effect of consecutive days.

4.7 Expanding to 5-day Analysis and the "Last Day" Effect

One potential mechanism for the observed reduction in officer actions on day four is a psychological "last day" effect that is unrelated to fatigue. To explore this hypothesis, I leverage day-off cancellations that occurred in 2021 and 2022. These cancellations affected all beat officers and resulted in the cancellation of their first day off after a specified date. For instance, a notice could be sent out on 01/01/2021 could cancel an officer's first assigned day off between 01/01/2021 and 01/04/2021, depending on an officer's assigned schedule. These notices were typically sent out several days in advance, requiring most officers to work five consecutive days. An example of one of these cancellation notices is provided in Appendix Figure A.11 and the temporal distribution of these notices are shown in Appendix Figure A.12. Unfortunately, due to data constraints, beat-assignment fixed effects are not available for these shifts.

While police officers frequently work overtime shifts outside this time frame, overtime is usually assigned endogenously, meaning it is strategically distributed to address rising crime levels or in response to idiosyncratic shocks. Using overtime shifts that are not uniformly assigned may introduce bias to estimates. By leveraging cancellations that uniformly affected all officers, I can mitigate much of the selection bias associated with who is assigned overtime. However, estimates need to be interpreted cautiously given that the circumstances of work may be different on day five. The primary objective of this analysis is to observe officer activity on the fourth day when they are required to work a fifth consecutive day, not activity levels on the fifth day.

Table 6 presents the results after incorporating shift spells that include a mandatory fifth day. This table is estimating by interacting each indicator variable in Equation 1 with an indicator equal to 1 if a shift spell is of length 5. Each shift spell analyzed here is exactly four or five days in length and shifts are restricted to 2021 and the beginning of 2022. Both shift spells of length four and five exhibit similar patters: an initial increase followed by a decrease on the fourth day. Estimates for four-day spells are attenuated, possibly because five-day spells occur during periods of high crime, which date fixed effects cannot fully account for. Nonetheless, the overall patterns between spells of length four and five are consistent. Interestingly, spells of length five have no detectable increase in use-of-force, however, since use-of-force is a rare event, these estimates are under-powered, and I cannot rule out large positive or negative changes.

The goal of this analysis is to rule out a "last day" effect, where officers might reduce their efforts on the fourth day simply because it is their final day. If this were not the case, we would expect to see elevated activity on day 4, rather than a consistent U-shaped relationship between days worked and activity. Estimates on day five should be interpreted with caution, as the assignments on day five may be substantially different from those on days one to four.

4.8 Robustness and Additional Heterogeneity

Table 8 presents results for each of the main outcomes with various sample selection or econometric model changes. For each robustness check, Panel A gives the results for arrests made, Panel B for stops made, and Panel C for force reported. Column 1 gives the main results from the preferred specification (identical to the main results shown in Figure 2)

The main results are consistent with each robustness check. Column 2 of Table 8 incorporates district-specific linear time trends, this helps adjust for gradual shifts at the district level, such as evolving leadership dynamics. Column 3 of Table 8 removes beat-assignment fixed effects. The consistency of results between Column 1 and Column 4 provide evidence that officers are not being endogenously sorted to assignments based on their number of consecutive days worked. Column 4 of Table 8 fully interacts each individual officer fixed effect with each beat-assignment fixed effect. This adds over 40,000 fixed effects and leads to comparisons within-officer-assignment. This fully interacted model leverages within-officer-assignment variation comparing the same officer assigned to the same assignment across different days. While this specification removes a great deal of variation in outcomes, it remains consistent with the preferred model in Column 1, further evidence that officers are not endogenously sorted into assignments. Column 5 of Table 8 reports the preferred specification from Column (1) estimated using ordinary least squares. Once these estimates are scaled by their respective mean values, their effect sizes are equivalent to the Poisson model.

Next I show that officers have similar outcomes based on which weekday they start their shift spell. This is shown in Figure 5, where each indicator is interacted with the day of week of the shifts spells first day. Additionally, stops conducted and force reported are provided in the appendix as Appendix Figure A.4 and Appendix Figure A.5, respectively. I find no significant difference in outcomes made by day of week for and any starting day. Despite weekdays being evenly distributed to officers, one may think officers have different impacts of stress and performance based on which day that they work. For example, a four-day shift spell that starts on Thursday and contains Saturday and Sunday may lead to different outcomes than one that does not contain a weekend. This null finding reinforces the conclusion that consecutive shifts uniformly tax officers' capacities, independent of the weekly cycle.

4.9 Alternative Policy Estimates

In this section I simulate alternative shift structures to demonstrate how policies that require fewer consecutive work days can lead to lower instances of force and fewer police officer injuries. To construct these estimates I create department-wide averages for first officer arrests, first officer investigatory stops, use-of-force reports, and officer injures. First-officer outcomes are used as to not inflate counts of arrests or stops due to arrests being repeatedly counted for each involved officer. Fist, the sum of each officer's outcomes are calculated on their first, second, third, and fourth consecutive work day. These sums are then combined using weighted average of these officer outcomes, with weights based on each officer's presence in the sample. That is, an officer who is present in my sample for two years will be twice weighted that of an officer who is present for one year.

The values are then applied across the full 6 year period of 2014 to 2022 to obtain estimates of the total amount of these outcomes that would occur. Importantly, these estimates assume the officer's activity is not policy-dependent. For example, this approach assumes that an officer's day two activity will be the same if it occurs in a work spell of three days or four days.

The current policy, where officers work 4 consecutive days followed by 2 days off will be further referred to as policy 1. I use these estimates of officer outcomes to simulate two alternative policies, Policy 2 and Policy 3, which maintain the same ratio working days and non-working days as the current schedule, Policy 1. Policy 2 has a structure 2/1, where an officer will work two days, followed by one day off. This structure has the same ratio of working days and non-working days as Policy 1, but has non-working days more frequent but in shorter stretches.

Policy 3 has a structure 3/2/3/1, where officers alternate between three days of work and breaks lasting one or two days. Similar to Policy 1 and Policy 2, Policy 3 preserves the same ratio of working days and non-working days. Specifically, over a twelve-day cycle under each policy, officers work eight out of the twelve days, ensuring that the workload distribution remains balanced across these different scheduling structures.

Estimates under policies 1, 2, and 3 are presented in Table 9A and compared against each other in Table 9B. By removing an officers fourth working day, both policies 2 and 3 reduce use-of-force incidents by 2.71% and 0.75% and reduce incidents of officer injuries by 2.45% and 1.73%, each respectively. The key differences between policies 2 and 3 are whether they include officers third working day. As seen in Section 4.1, the third working day is a productive working day with high levels of arrests made and stops conducted when compared to an officer's first day. Since Policy 2 does not contain three consecutive working days, there is a decline in the total arrest made and investigatory stops conducted. On the other hand, Policy 3 is able to both increase productive policing measures (total arrests and stops) while decreasing use-of-force and officer injuries. w

In summary, the simulations of alternative shift structures policies indicate that reducing the number of consecutive workdays can decrease the incidence of use-of-force events and officer injuries. The implementation of a 2/1 work-rest cycle (Policy 2) or a 3/2/3/1 cycle (Policy 3) both lower these outcomes compared to the current 4/2 structure (Policy 1). In fact, Policy 3 is able to reduce use-of-force incidents while simultaneously increase both total arrests made and stops conducted. These findings suggest that adjusting shift schedules could enhance officer safety and potentially improve community interactions, emphasizing the need for policy adjustments that consider both officer welfare and operational effectiveness.

5 Conclusion

This study examines the effect of shift structure on police officer performance. The findings indicate that initially, police officers experience a marked increase in total arrests made, and total stops conducted of approximately 6% from the first to the second day of their shift cycle. This increase is short-lived as by the fourth day, the number of arrests and stops declines to levels at or below those observed on the initial day. However, police officers show no declines in the amount of force used.

The persistence rise in force despite reduced proactive engagement raises concerns about the potential influences of fatigue, aggression, and frustration on officer behavior. This is further evidenced by an increase in "tack-on" discretionary arrests for minor offenses, delayed response times to emergency calls, and reduced patrolling activity. Additionally, officers are more likely to become injured by their fourth day.

The significance of these results underscores the need for police departments to carefully evaluate shift schedules to enhance officer effectiveness and reduce the risks associated with extended duty periods. This paper provides new evidence that police officers are susceptible to cognitive depletion and may not provide consistent public safety as their endurance could be affected. These dynamics call for a reevaluation of current shift scheduling practices in policing to mitigate these adverse effects and enhance both officer well-being and public safety. Ultimately, this line of research not only aids in enhancing police performance but also contributes to the broader discussion on workplace productivity and worker welfare across various sectors. Law enforcement, health care, and emergency services are all professions where prolonged work periods can have large potential costs.

However, in the realm of law enforcement, it is important to consider the counterfactual of extended police shifts. It is possible that the costs of giving police more frequent time off, and thus reducing the number of police officers on duty, could exceed the gains from increased rest. The presence of a police officer, even while not actively patrolling or engaging in proactive policing, has potential to deter crime. Any change in the shift structure of a police force needs to be considered holistically, from the perspective of an officer, the community, and the city before being implemented. Lastly, this paper highlights the need for consideration of police officers physical and mental health when making personnel decisions.

Future research should delve deeper into the mechanisms driving the observed behaviors, particularly the role of cognitive stress and fatigue in police officer decision-making. Exploring the impact of different shift lengths and rest intervals could offer insights into more sustainable work patterns. In recent years, departments have experimented with different shift structures to attract new officers and improve officer health, such as a four-day work week in Seattle, WA and a 32-hour work week in Golden, CO. Further work is needed to understand new shift schedules and shift schedules that give officer's more time off, could have positive benefits for officer's physical and mental health and improve their relations with their communities.

References

Anderson, D. A. (2021). The Aggregate Cost of Crime in the United States. *The Journal of Law and Economics*, 64(4):857–885.

Ang, D. (2021). The effects of police violence on inner-city students. *The Quarterly Journal of Economics*, 136(1):115–168.

Ba, B., Bayer, P., Rim, N., Rivera, R., and Sidibé, M. (2021). Police Officer Assignment and Neighborhood Crime. *NBER Working Paper*.

Bavafa, H. and Jónasson, J. O. (2023). The Distributional Impact of Fatigue on Performance. *Management Science*.

Brachet, T., David, G., and Drechsler, A. M. (2012). The Effect of Shift Structure on Performance. *American Economic Journal: Applied Economics*, 4(2):219–246.

Brown, C. L., Kaur, S., Kingdon, G., and Schofield, H. (2022). Cognitive endurance as human capital. Technical report, National Bureau of Economic Research.

Caplin, A. and Martin, D. (2016). The dual-process drift diffusion model: Evidence from response times. *Economic Inquiry*, 54(2):1274–1282.

Castillo, M., Dickinson, D. L., and Petrie, R. (2017). Sleepiness, choice consistency, and risk preferences. *Theory and Decision*, 82:41–73.

Chalfin, A. and Goncalves, F. (2020). The Pro-Social Motivations of Police Officers.

Chan, D. C. (2018). The efficiency of slacking off: Evidence from the emergency department. *Econometrica*, 86(3):997–1030.

Chen, M. K., Christensen, K. L., John, E., Owens, E., and Zhuo, Y. (2023). Smartphone Data Reveal Neighborhood-Level Racial Disparities in Police Presence. *The Review of Economics and Statistics*, pages 1–29.

Collewet, M. and Sauermann, J. (2017). Working hours and productivity. *Labour Economics*, 47:96–106.

CPD (2020). Incidents Requiring the Completion of a Tactical Response Report. https://directives.crimeisdown.com/directives/data/a7a57be2-1291da66-88512-91e2-cdd76fd8ae76d83d.html?commit=6668c0ec3724e2850565d2d023aaaf615f0c2d64.

Di Tella, R. and Schargrodsky, E. (2004). Do Police Reduce Crime? Estimates Using the Allocation of Police Forces After a Terrorist Attack. *American Economic Review*, 94(1):115–133.

Draca, M., Machin, S., and Witt, R. (2011). Panic on the Streets of London: Police, Crime, and the July 2005 Terror Attacks. *American Economic Review*, 101(5):2157–2181.

Dube, O., MacArthur, S. J., and Shah, A. K. (2023). A cognitive view of policing. Technical report, National Bureau of Economic Research.

Eden, M. (2021). Time-inseparable labor productivity and the workweek. *The Scandinavian journal of economics*, 123(3):940–965.

Erosa, A., Fuster, L., Kambourov, G., and Rogerson, R. (2017). Hours, occupations, and gender differences in labor market outcomes. Technical report, National Bureau of Economic Research.

Evans, W. N. and Owens, E. G. (2007). COPS and crime. *Journal of Public Economics*, 91(1):181–201.

Federation, T. C. (2022). Chicago Police Department Staffing Analysis. https://www.civicfed.org/civic-federation/blog/chicago-police-department-staffing-analysis.

Fu, C. and Wolpin, K. I. (2018). Structural Estimation of a Becker-Ehrlich Equilibrium Model of Crime: Allocating Police Across Cities to Reduce Crime. *The Review of Economic Studies*, 85(4):2097–2138.

Huffmyer, J. L., Moncrief, M., Tashjian, J. A., Kleiman, A. M., Scalzo, D. C., Cox, D. J., and

Nemergut, E. C. (2016). Driving Performance of Residents after Six Consecutive Overnight Work Shifts. *Anesthesiology*, 124(6):1396–1403.

Kamstra, M. J., Kramer, L. A., and Levi, M. D. (2000). Losing sleep at the market: The daylight saving anomaly. *American Economic Review*, 90(4):1005–1011.

Kant, I., Bültmann, U., Schröer, K., Beurskens, A., Van Amelsvoort, L., and Swaen, G. (2003). An epidemiological approach to study fatigue in the working population: the maastricht cohort study. *Occupational and environmental medicine*, 60(suppl 1):i32–i39.

Levitt, S. D. (1997). Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime. *The American Economic Review*, 87(3):270–290.

McCrary, J. (2002). Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime: Comment. *American Economic Review*, 92(4):1236–1243.

Mello, S. (2019). More COPS, less crime. *Journal of Public Economics*, 172:174–200.

Nasca, T. J., Day, S. H., and Amis, E. S. (2010). The New Recommendations on Duty Hours from the ACGME Task Force. *New England Journal of Medicine*, 363(2):e3.

NBC (2022). Chicago cops could decline excessive hours under proposed ordinance.

NLEOMF (2023). Law Enforcement Facts. https://nleomf.org/memorial/facts-figures/law-enforcement-facts/.

NY DCJS (2023). Law Enforcement Personnel by Agency: Beginning 2007. https://data.ny.gov/Public-Safety/Law-Enforcement-Personnel-by-Agency-Beginning-2007/khn9-hhpq.

Owens, E. and Ba, B. (2021). The Economics of Policing and Public Safety. *Journal of Economic Perspectives*, 35(4):3–28.

Pencavel, J. (2015). The Productivity of Working Hours. *The Economic Journal*, 125(589):2052–2076.

Pratt, G. (2022). Mayor lori lightfoot says chicago cops have ‘incredible amount’ of time off, disputes criticism they’re overworked. *Chicago Tribune*.

Salfi, F., Lauriola, M., Tempesta, D., Calanna, P., Socci, V., De Gennaro, L., and Ferrara, M. (2020). Effects of Total and Partial Sleep Deprivation on Reflection Impulsivity and Risk-Taking in Deliberative Decision-Making. *Nature and Science of Sleep*, 12:309–324.

Schilbach, F. (2019). Alcohol and self-control: A field experiment in india. *American economic review*, 109(4):1290–1322.

Spielman, F. and Charles, S. (2019). Plan to change some cpd officers’ start times ”rescinded” for now as police officers’ union explores ”legal options”.

Times, L. A. (2021). LAPD after George Floyd: Fewer officers, fewer arrests but hardly defunded. https://www.latimes.com/california/story/2021-05-30/george-floyd-protests-altered-landscape-for-lapd.

Van Veen, M. M., Lancel, M., Şener, O., Verkes, R. J., Bouman, E. J., and Rutters, F. (2022). Observational and experimental studies on sleep duration and aggression: A systematic review and meta-analysis. *Sleep Medicine Reviews*, 64:101661.

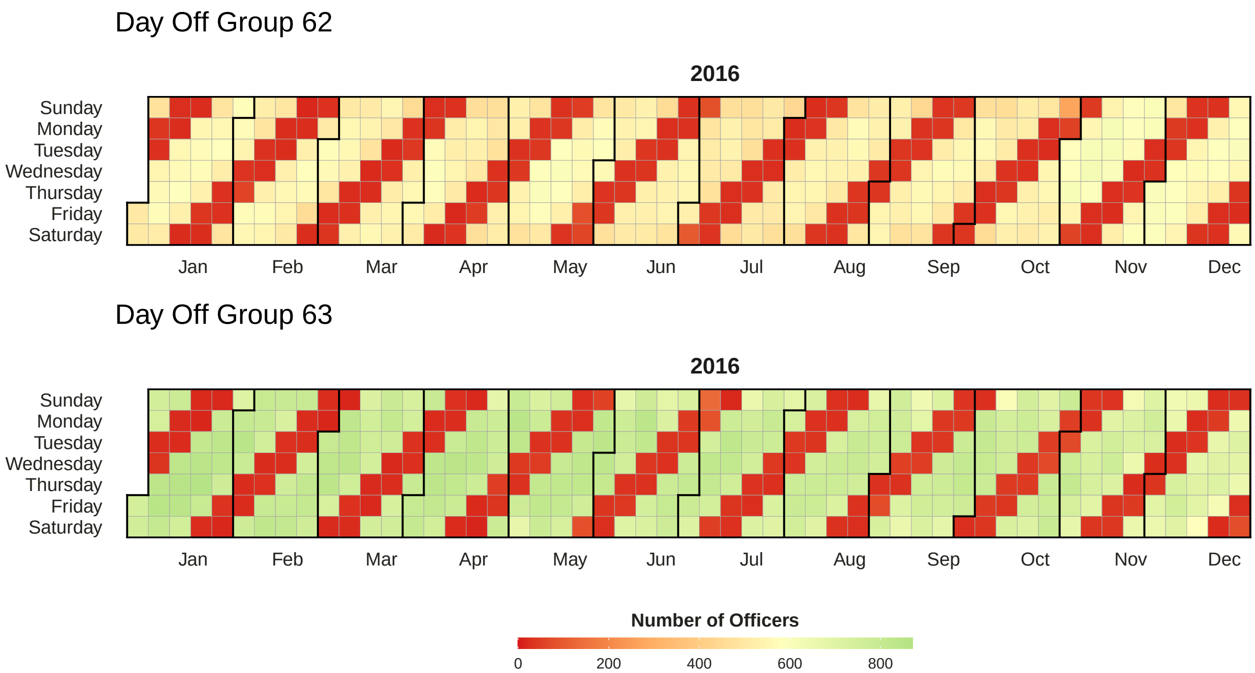
Vila, B. (2000). *Tired Cops: The Importance of Managing Police Fatigue*.

Weisburst, E. K. (2019). Safety in Police Numbers: Evidence of Police Effectiveness from Federal COPS Grant Applications. *American Law and Economics Review*, 21(1):81–109.

Zhang, Y., Peters, A., and Bradstreet, J. (2018). Relationships among sleep quality, coping styles, and depressive symptoms among college nursing students: A multiple mediator model. *Journal of Professional Nursing*, 34(4):320–325.

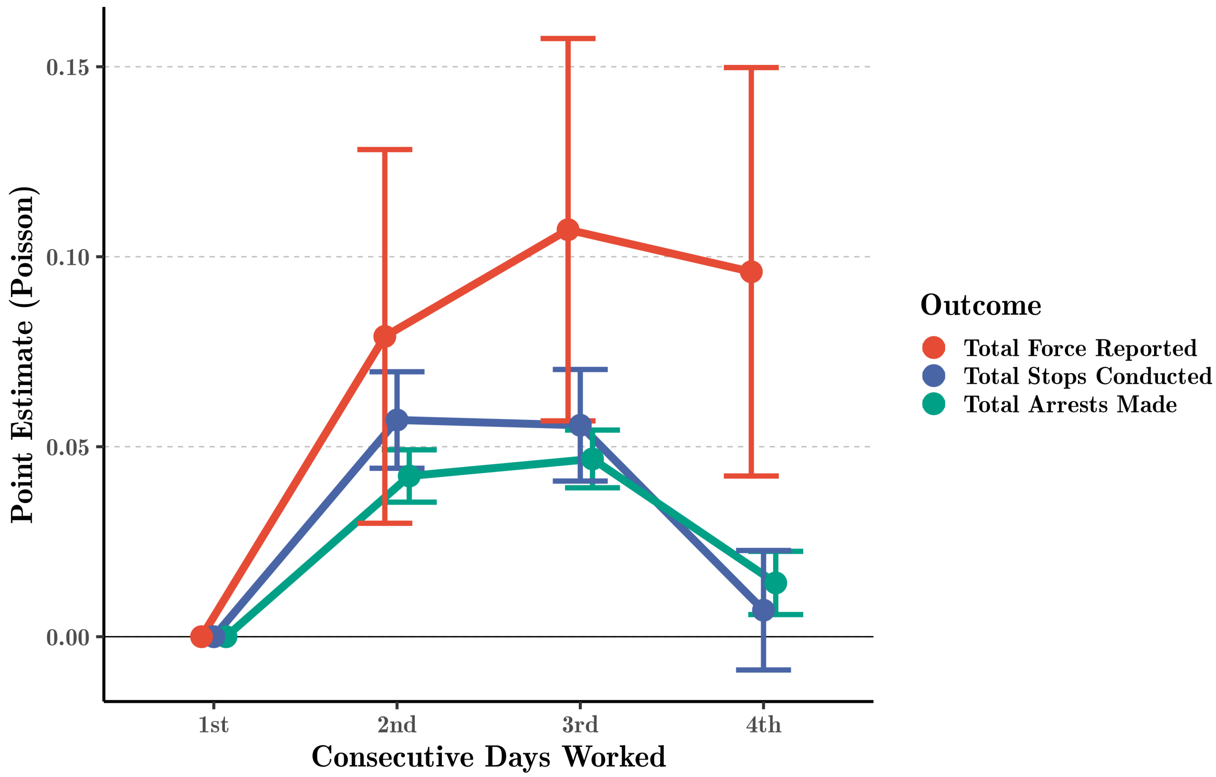
Figures

Figure 1: Day Off Group Scheduling Example, 2016



Note(s): Number of officers includes all sworn officers who are marked as present. There are several notable days with variation, (1) July 2nd to 3rd was a music festival that required officers in DOG 62 and 63 to work on their off day, (2) October 30th marked the deadliest weekend of the year and officers in DOG 62 were called in, DOG 63 officers were already working. There are 20 possible day off groups, but 6 groups (61 to 66), which correspond to the 4-2 9-hour structure, contain 86% of all officers.

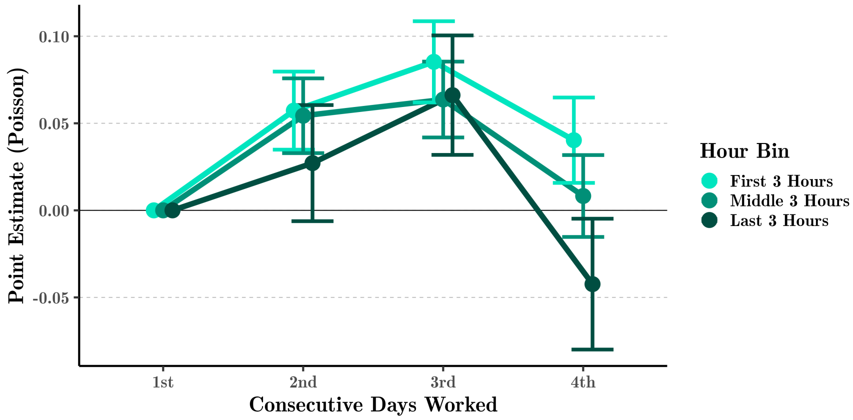
Figure 2: Relationship Between Days Worked and Main Outcomes



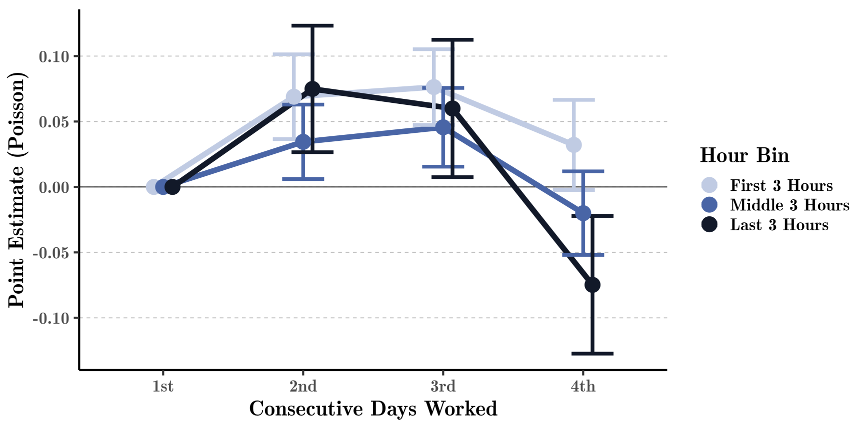
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Arrests and stops are only counted for the first officer (not second or assisting officers). Officer, date, and beat-assignment fixed effects are included.

Figure 3: Main Outcomes Split into 3-Hour Bins

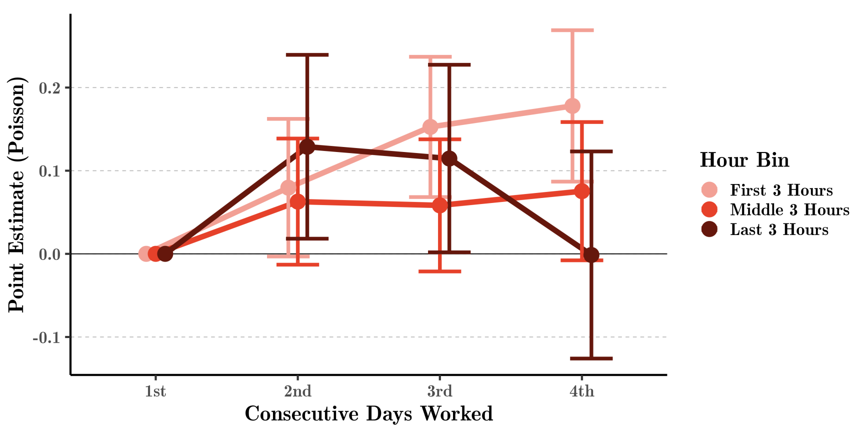
(a) Total Arrests Made



(b) Total Stops Conducted

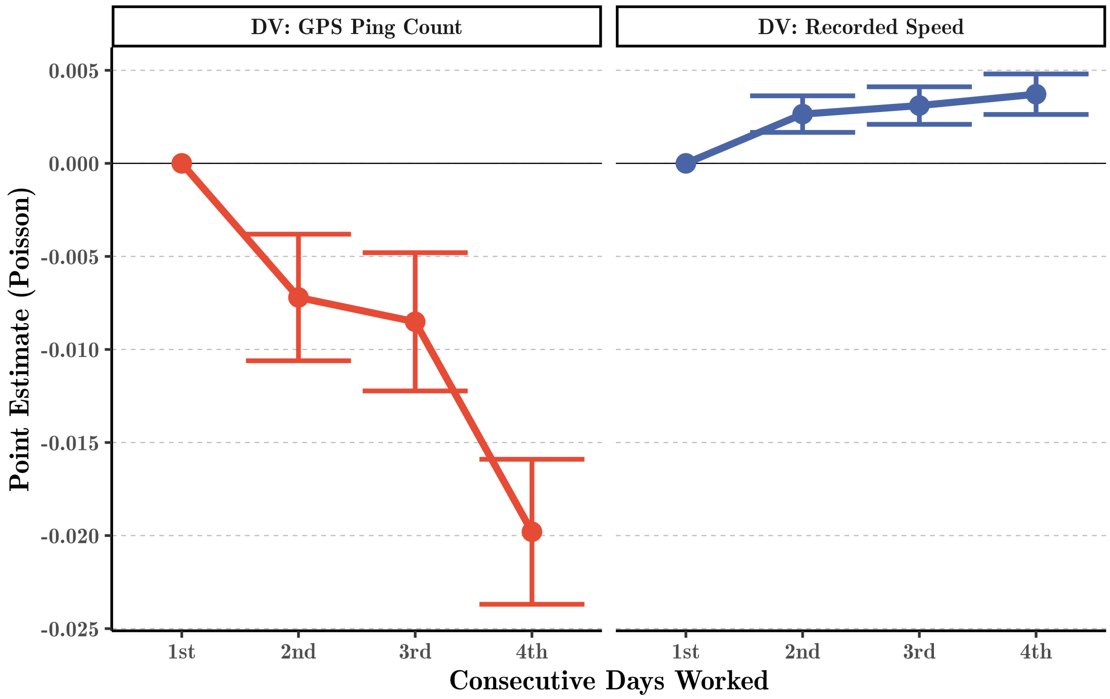


(c) Total Force Reported



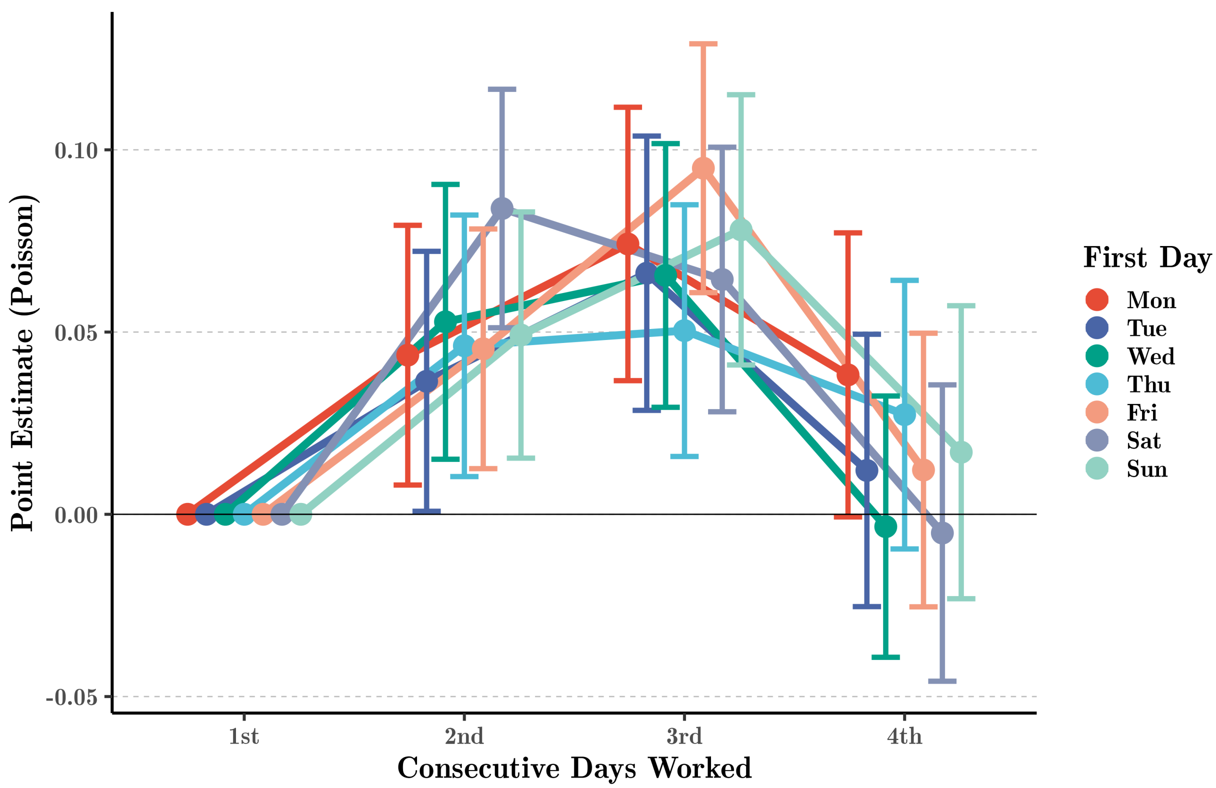
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Analysis restricts to shifts of 9 hours, then divided into three hour bins. Typically, officers will spend the first 45 minutes and final 15 minutes doing roll-call and debriefing. Officer, date, and beat-assignment fixed effects are included.

Figure 4: Relationship Between Days Worked and GPS Pings



Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Dependent variable is the count of GPS pings associated with an officers patrol car or the recorded speed at the time of a ping. Sample only includes officer-days that have at least one ping.

Figure 5: Effect on Total Arrests, Split by Day of Week of First Shift



Note(s): This figure depicts a single regression where treatment effect for days 2 to 4 are interacted with an indicator variable based on the weekday of the first day of their shift spell. Also included is an un-interacted indicator variable for each day of the week that shift spell starts. That is, all estimates are relative to a shift spells first day conditional on starting on the same weekday.

Tables

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Table 1: Summary Statistics

	Mean	SD	Min	Max
Total Arrests Made	0.160	0.513	0	42
As First Officer	0.034	0.202	0	13
As Second Officer	0.032	0.196	0	13
As Assisting Officer	0.094	0.413	0	42
Non-discretionary	0.159	0.511	0	42
Discretionary	0.001	0.038	0	5
Total Stops Conducted	0.097	0.487	0	19
As First Officer	0.054	0.332	0	19
As Second Officer	0.043	0.297	0	19
Total Force Reported	0.008	0.173	0	19
Total Force Reports Filed	0.003	0.058	0	8
With Officer Injured	0.001	0.027	0	8
With Civilian Injured	0.001	0.029	0	7

Note:
Observation level is officer-day and spans 01/2014 to 12/2020. Dispatch time is measured in minutes. The top 1% of each dispatch time is removed for data quality this cutoffs are given as the emphMax. *Total Force Reports Filed* measures the number of individual reports filed by and officer, while *Total Force Reported* measures the number of actions in that force report (e.g. firearm discharged, physical takedown, armbar performed).

Table 2: Poisson Estimates for *Day Worked Number* and Arrest Types

	Discretionary?		*Charge Category for Arrest*					
	No	*Yes*	*Violent*	*Property*	*Narcotics*	*Warrant*	*Traffic*	*Other*
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Day Worked Number								
× Day 1	-	-	-	-	-	-	-	-
× Day 2	0.042***	0.069**	0.025*	0.048***	0.044	0.056***	0.082***	0.092***
	(0.004)	(0.032)	(0.013)	(0.012)	(0.027)	(0.018)	(0.018)	(0.022)
× Day 3	0.047***	0.076**	0.033**	0.071***	0.103***	0.045**	0.084***	0.152***
	(0.004)	(0.034)	(0.014)	(0.013)	(0.028)	(0.018)	(0.018)	(0.024)
× Day 4	0.014***	0.081**	0.003	0.028**	0.001	0.003	-0.021	0.093***
	(0.004)	(0.036)	(0.015)	(0.014)	(0.031)	(0.019)	(0.015)	(0.024)
Mean of Dependent Variable	0.159	0.001	0.008	0.010	0.002	0.005	0.007	0.003
Observations	4006491	1426522	3038467	3060152	1189337	2522066	2130608	2039006

Note:
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observation level is officer-day and spans 01/2014 to 12/2020. The dependent variable is a count of outcomes that an officer is involved and is estimated via Poisson. Standard errors are clustered at the individual level.

Table 3: Poisson Estimates for *Day Worked Number* and Officer and Civlian Injury

	Injury To:	
	Officer	*Civilian*
	(1)	(2)
Day Worked Number		
$\times$ Day 1	-	-
$\times$ Day 2	0.0115	0.0699*
	(0.0448)	(0.0415)
$\times$ Day 3	0.0358	0.0550
	(0.0467)	(0.0431)
$\times$ Day 4	0.0964**	0.0716
	(0.0486)	(0.0451)
Mean of Dependent Variable	0.0007	0.0008
Observations	978413	920629

Note:
* p < 0.1, ** p < 0.05, *** p < 0.01. Observation level is officer-day and spans 01/2014 to 12/2020. The dependent variable is the count of TRR reports that include a flag for officer or civilian injury and is estimated via Poisson. Standard errors are clustered at the individual level.

Table 4: Poisson Estimates for *Day Worked Number* and Race of Civilian

	Race of Civilian		
	Black	*Hispanic*	*White*
	(1)	(2)	(3)
		Panel A: Arrests Made	
Day Worked Number			
× Day 2	0.043***	0.071***	0.086***
	(0.009)	(0.019)	(0.021)
× Day 3	0.065***	0.076***	0.090***
	(0.009)	(0.019)	(0.023)
× Day 4	0.015	-0.022	0.054**
	(0.010)	(0.018)	(0.024)
Mean of Dependent Variable	0.018	0.006	0.003
Observations	2511798	1788240	1477905
		Panel B: Stops Conducted	
Day Worked Number			
× Day 2	0.061***	0.068***	0.040
	(0.011)	(0.023)	(0.028)
× Day 3	0.068***	0.034*	0.032
	(0.011)	(0.018)	(0.025)
× Day 4	0.005	0.019	-0.031
	(0.012)	(0.024)	(0.031)
Mean of Dependent Variable	0.035	0.013	0.005
Observations	3205286	2310539	2086526
		Panel C: Force Reported	
Day Worked Number			
× Day 2	0.094***	0.095*	0.084
	(0.025)	(0.054)	(0.074)
× Day 3	0.120***	0.031	0.075
	(0.026)	(0.059)	(0.077)
× Day 4	0.114***	0.092	0.083
	(0.028)	(0.061)	(0.081)
Mean of Dependent Variable	0.002	0.001	0.000
Observations	2454472	474106	189310

Note:
* p < 0.1, ** p < 0.05, *** p < 0.01. Observation level is officer-day and spans 01/2014 to 12/2022. The dependent variable is a count of outcomes that an officer is involved and is estimated via Poisson. Standard errors are clustered at the individual level.

Table 5: Poisson Estimates for *Day Worked Number* and Officer Tenure (Years)

	Years of Tenure		
	0 to 5 Years	*5 to 20 Years*	*20 or More Years*
	(1)	(2)	(3)
	Panel A: Arrests Made		
Day Worked Number			
× Day 2	0.048***	0.063***	0.024
	(0.010)	(0.012)	(0.025)
× Day 3	0.065***	0.089***	0.030
	(0.010)	(0.012)	(0.024)
× Day 4	0.026**	0.005	0.016
	(0.012)	(0.012)	(0.026)
Mean of Dependent Variable	0.053	0.031	0.015
Observations	1114445	1698169	520833
	Panel B: Stops Conducted		
Day Worked Number			
× Day 2	0.053***	0.093***	0.025
	(0.011)	(0.029)	(0.030)
× Day 3	0.048***	0.084***	0.070**
	(0.011)	(0.017)	(0.031)
× Day 4	0.002	0.024	0.016
	(0.012)	(0.031)	(0.036)
Mean of Dependent Variable	0.097	0.037	0.019
Observations	1201594	1056377	352125
	Panel C: Force Reported		
Day Worked Number			
× Day 2	0.091**	0.114***	-0.068
	(0.036)	(0.038)	(0.091)
× Day 3	0.114***	0.134***	-0.050
	(0.038)	(0.039)	(0.092)
× Day 4	0.128***	0.096**	-0.011
	(0.040)	(0.043)	(0.091)
Mean of Dependent Variable	0.012	0.008	0.003
Observations	816909	1292231	142831

Note:
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observation level is officer-day and spans 01/2014 to 12/2022. The dependent variable is a count of outcomes that an officer is involved and is estimated via Poisson. Standard errors are clustered at the individual level.

Table 6: Poisson Estimates for *Day Worked Number* using Cancelled Off Days

	Total Arrests Given	*Total Stops Conducted*	*Total Force Reported*
	(1)	(2)	(3)
Day Worked Number			
× Spell Length 4			
× Day 2	0.053***	0.042**	0.114
	(0.019)	(0.016)	(0.076)
× Day 3	0.054***	0.061***	0.165**
	(0.018)	(0.014)	(0.072)
× Day 4	-0.042**	-0.061***	0.151**
	(0.019)	(0.017)	(0.073)
× Spell Length 5			
× Day 2	0.079	0.146***	0.219
	(0.053)	(0.041)	(0.231)
× Day 3	0.100**	0.142***	0.030
	(0.050)	(0.038)	(0.246)
× Day 4	0.001	0.000	-0.133
	(0.057)	(0.043)	(0.246)
× Day 5	-0.930***	-0.804***	-0.683**
	(0.079)	(0.060)	(0.328)
Mean of Dependent Variable	0.022	0.059	0.004
Observations	630020	786285	289960

Note:
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observation level is officer-day and spans 01/2014 to 12/2022. The dependent variable is a count of outcomes that an officer is involved and is estimated via Poisson. Sample is restricted to 2021 and 2022 and contains only shift spells of 4 or 5 days. Shift spells of 5 days contain 4 consective regular days followed by 1 involuntary overtime day. Included are fixed effects for officer, date, and district. Standard errors are clustered at the individual level.

Table 7: Poisson Estimates for *Day Worked Number* and Priority 1 Dispatch Time

	Total Time	*Time Segments*		
	Entry to Onscene	*Entry to Dispatch*	*Dispatch to Enroute*	*Enroute to Onscene*
	(1)	(2)	(3)	(4)
Day Worked Number				
$\times$ Day 1	-	-	-	-
$\times$ Day 2	0.000	0.002	0.005	0.001
	(0.002)	(0.003)	(0.005)	(0.003)
$\times$ Day 3	0.002	0.005	0.004	0.003
	(0.002)	(0.003)	(0.005)	(0.003)
$\times$ Day 4	0.003	0.000	0.012**	0.004
	(0.003)	(0.003)	(0.006)	(0.003)
Mean of Dependent Variable	17.546	6.911	2.649	7.986
Observations	1218421	1536812	1535162	1149491

Note:
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observation level is officer-day and spans 01/2014 to 12/2020. The dependent variable is mean time (minutes) of 911 call dispatches per day and is estimated via Poisson. Standard errors are clustered at the individual level.

Table 8: Robustness Table

	Preferred Model (1)	*No Beat-Assignment FE* (2)	*Unit Linear Trends* (3)	*Officer-Beat-Assignment FE* (4)	*OLS* (5)
			Panel A: Arrests Made		
Day Worked Number					
× Day 2	0.051***	0.054***	0.052***	0.048***	0.0018***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.0002)
× Day 3	0.071***	0.071***	0.071***	0.072***	0.0024***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.0003)
× Day 4	0.014*	0.010	0.014*	0.011	0.0002*
	(0.008)	(0.008)	(0.008)	(0.008)	(0.0003)
Mean of Dependent Variable	0.034	0.034	0.034	0.034	0.0337
Observations	3480251	3612392	3480251	2284322	5323345
			Panel B: Stops Conducted		
Day Worked Number					
× Day 2	0.057***	0.066***	0.062***	0.060***	0.0034***
	(0.006)	(0.011)	(0.011)	(0.012)	(0.0006)
× Day 3	0.056***	0.066***	0.057***	0.052***	0.0032***
	(0.007)	(0.009)	(0.009)	(0.010)	(0.0005)
× Day 4	0.007	0.010	0.005	0.004	0.0002
	(0.008)	(0.012)	(0.012)	(0.013)	(0.0006)
Mean of Dependent Variable	0.054	0.054	0.054	0.054	0.0538
Observations	2998927	2880755	2755257	1631366	3542261
			Panel C: Force Reported		
Day Worked Number					
× Day 2	0.079***	0.077***	0.079***	0.070***	0.0006***
	(0.025)	(0.025)	(0.025)	(0.026)	(0.0002)
× Day 3	0.107***	0.099***	0.107***	0.104***	0.0008***
	(0.026)	(0.026)	(0.026)	(0.027)	(0.0002)
× Day 4	0.096***	0.084***	0.096***	0.109***	0.0008***
	(0.027)	(0.027)	(0.027)	(0.029)	(0.0002)
Mean of Dependent Variable	0.008	0.008	0.008	0.008	0.0081
Observations	3007717	3229640	3007717	1309220	5323345

Note:
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$. Observation level is officer-day and spans 01/2014 to 12/2020. The dependent variable is a count of outcomes that an officer is involved and is estimated via Poisson or OLS in Column (5) Standard errors are clustered at the individual level.

Policy 1: 4 days on, 2 days off

Work	Work	Work	Work	Off	Off

Policy 2: 2 days on, 1 day off, repeat

Work	Work	Off	Work	Work	Off

Policy 3: 3 days on, 1 day off, 3 days on, 2 days off

Work	Work	Work	Off	Work	Work	Work	Off	Off

Table 9A: Total Outcomes Under Alternative Work Schedules, 2014-2020

	Policy 1	*Policy 2*	*Policy 3*
Arrests	179,756	178,033	180,698
Stops	246,837	244,441	247,698
Use-of-Force	43,163	41,993	42,840
Officer Injuries	3,756	3,664	3,691

Table 9B: Comparisons Between Alternative Work Schedules, 2014-2020

	Change from Policy 1 to 2		*Change from Policy 1 to 3*	
	Net Change	*Percent*	*Net Change*	*Percent*
Arrests	-1,723	-0.96%	942	0.52%
Stops	-2,396	-0.97%	861	0.35%
Use-of-Force	-1,170	-2.71%	-323	-0.75%
Officer Injuries	-92	-2.45%	-65	-1.73%

Note:
This analysis assumes that officer behavior is not policy-dependent. Outcomes for each officer are summed by Day Worked Number and then weighted each officers frequency to obtain department-wide mean outcomes at the daily level. These daily averages summed over the six-year study period from 2014 to 2020.

Appendix

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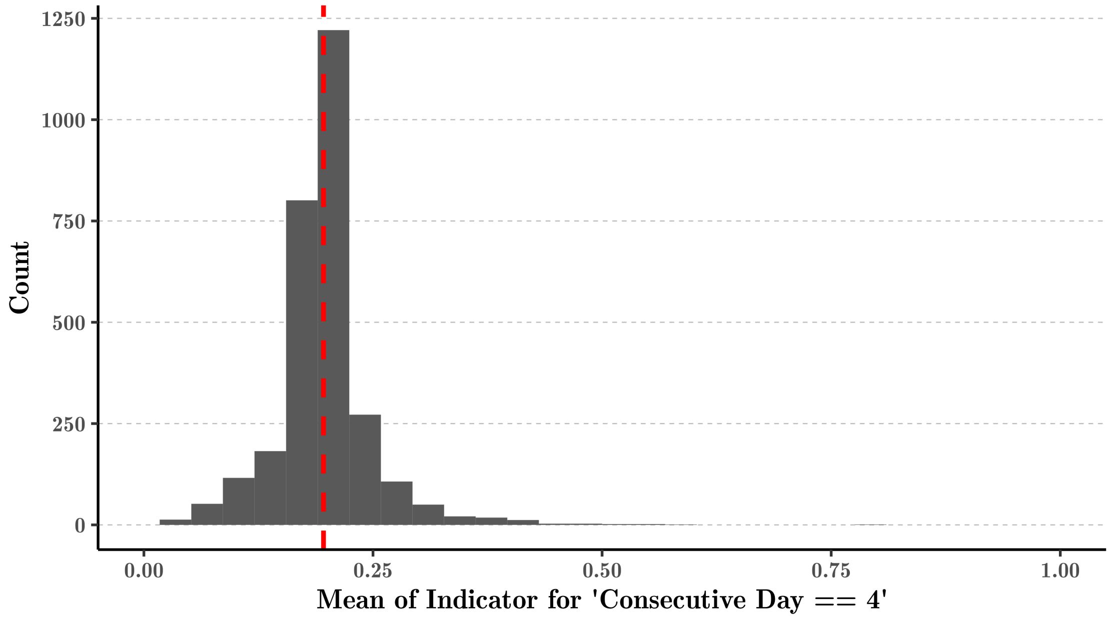
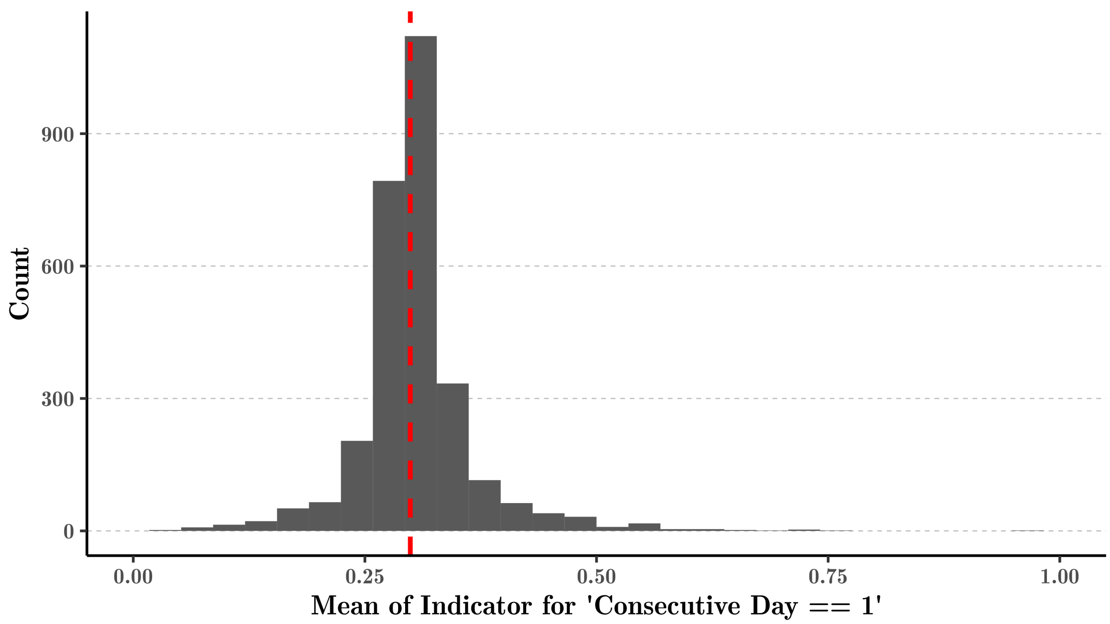
Figure A.1: Mean of Day 1 of 4 Indicator by Assignment

(a) Day 4 Indicator

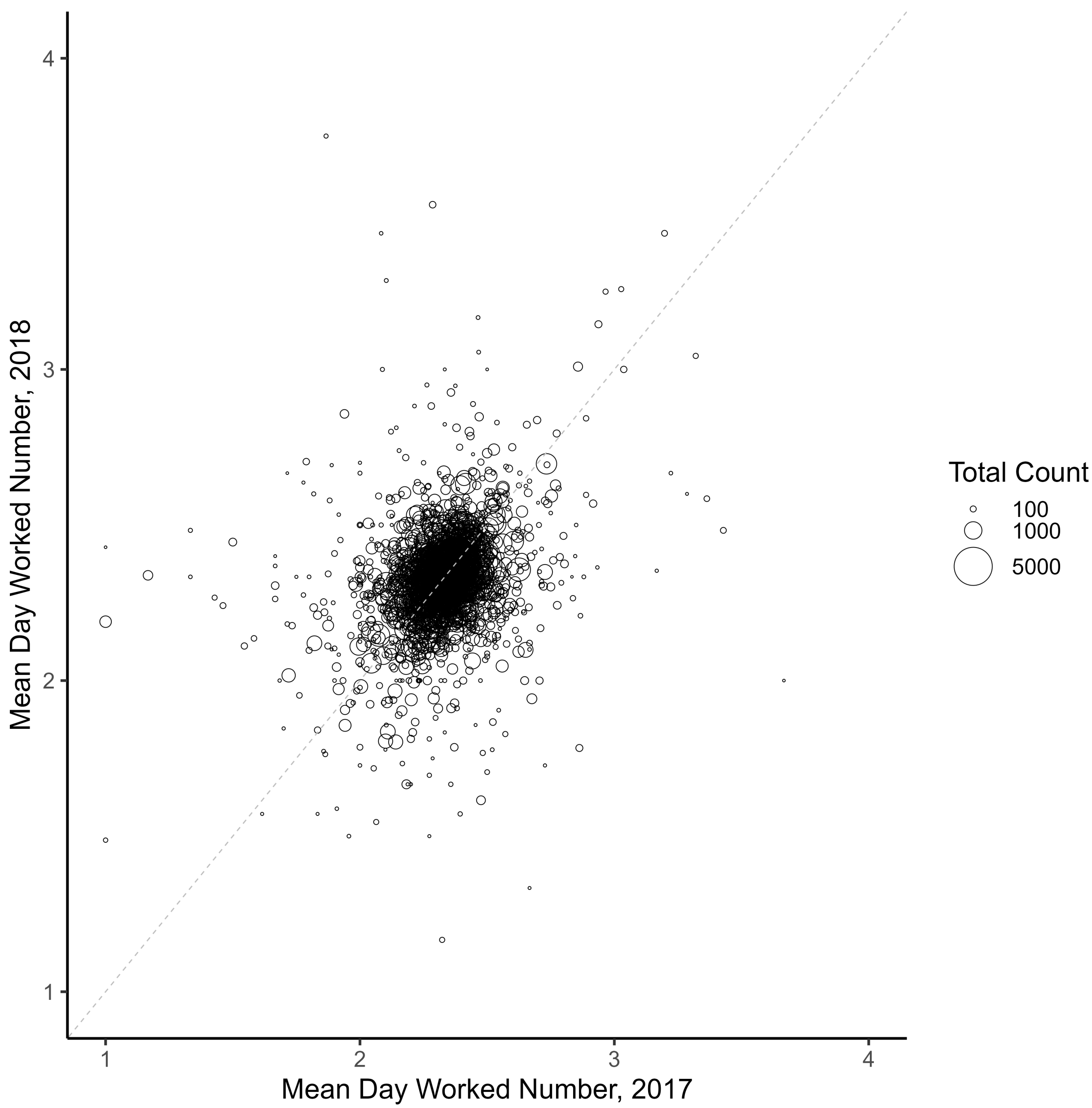


(b) Day 1 Indicator



Note(s): Panel A of this figure gives the mean of an indicator that is equal to 1 for an officers 4th day. This indicator is then averaged by beat-assignment and a histogram is plotted. The intuition here is that if there were a specific assignment that was always given to officers on the 4th day (a threat to identification), then there would be a mass of assignments whose indicator would have a large mean. The dashed red line gives the mean if all assignments were given completely randomly (if all shift spells were length 4 this would be 0.25). Panel (B) does the same but for an officer's first day.

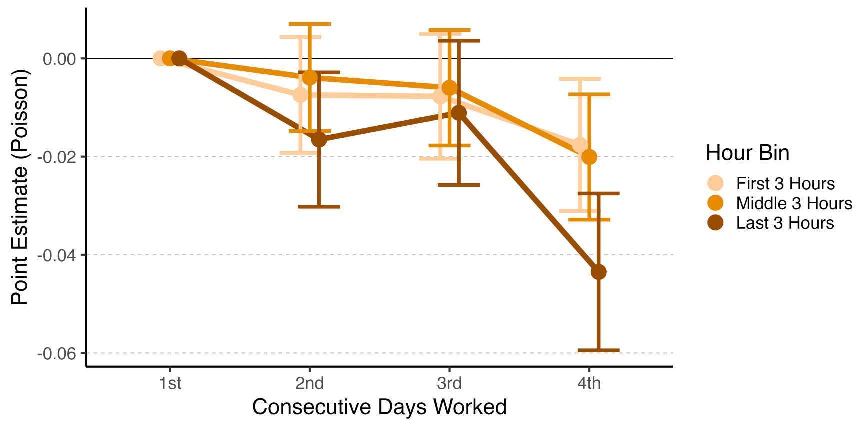
Figure A.2: Mean of *Day Worked Number* by Beat Assignment, 2017 and 2018



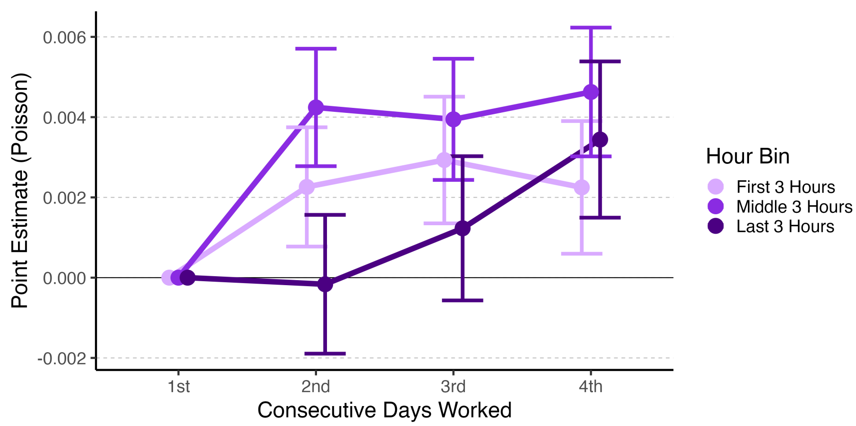
Note(s): This figure compares the mean of *Day Worked Number* in 2017 versus 2018 for each individual beat-assignment. Each circle is a separate possible assignment and the size of a circle denotes the total observations over these two years. The y-axis gives the mean for 2018 and the x-axis gives the mean for 2017. This figure shows that day worked numbers are not bunched in certain assignments. That is, there are not assignments that officers are always put into on their first or last day. Additionally,

Figure A.3: Dispatch Outcomes Split into 3-Hour Bins

(a) GPS Pings Count

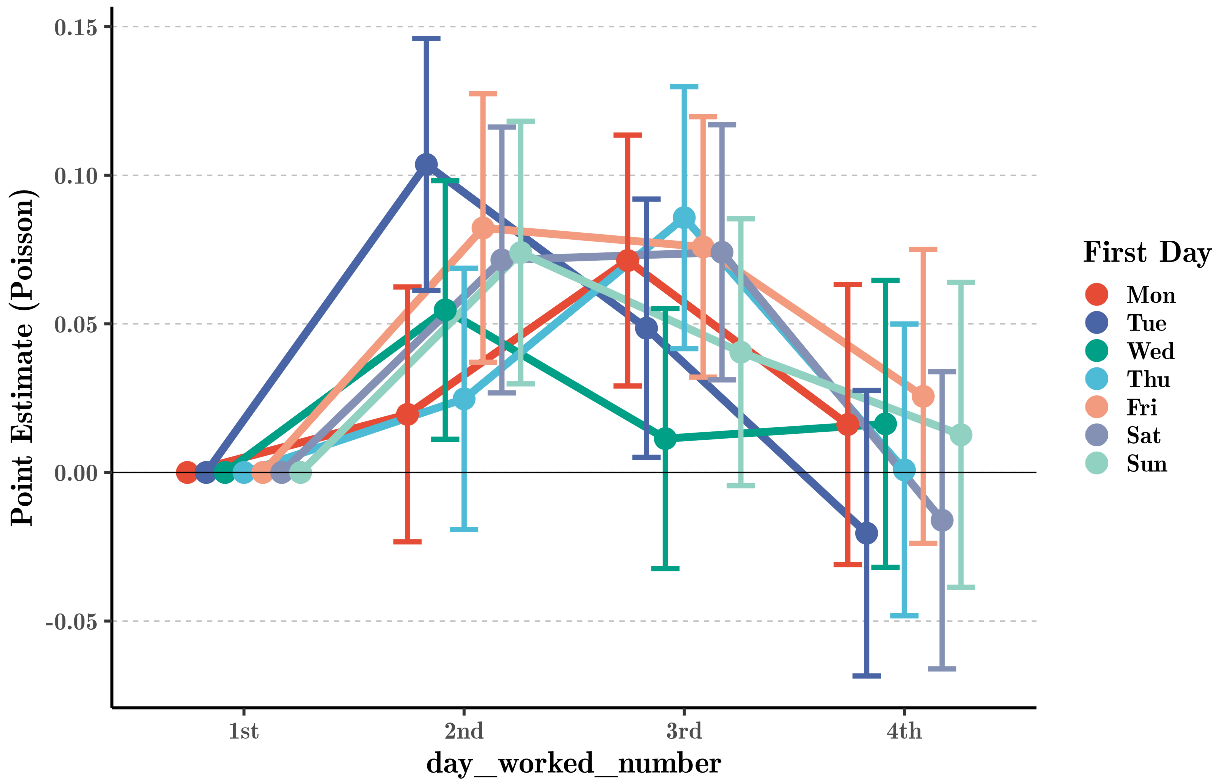


(b) Recorded Speed of Ping



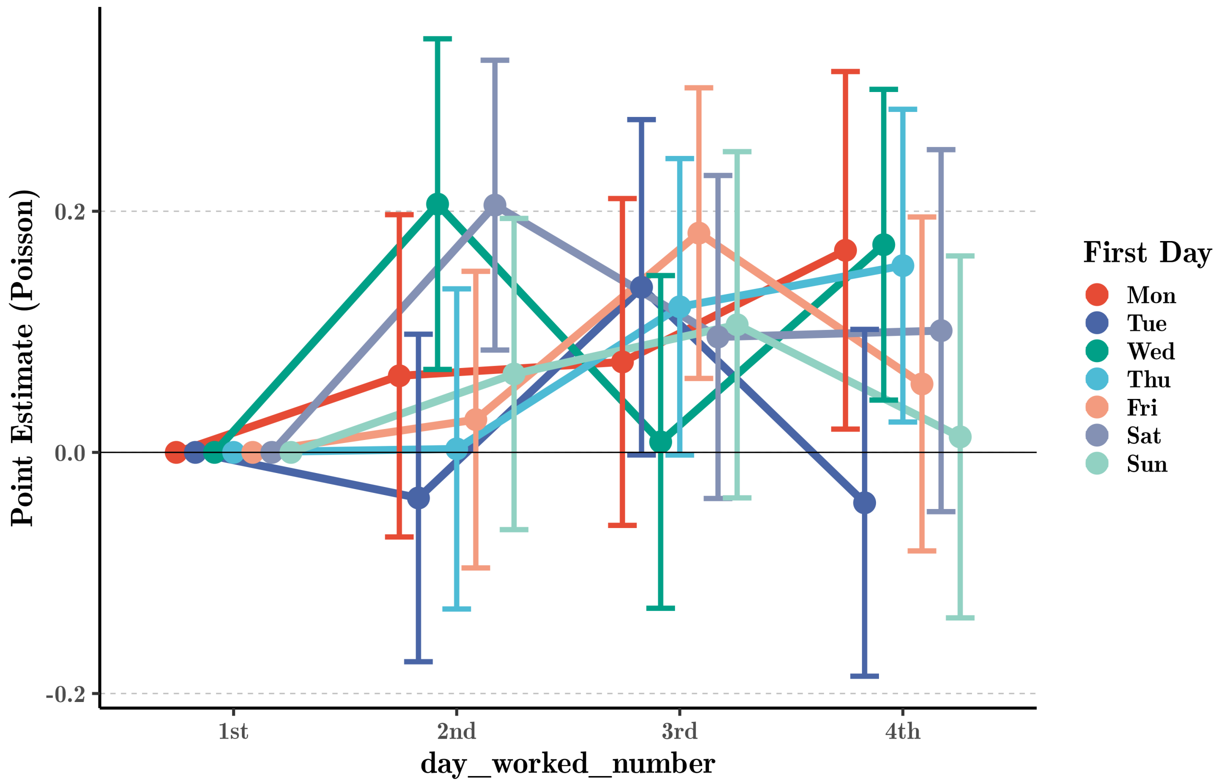
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Analysis restricts to shifts of 9 hours, then divided into three hour bins. Typically, officers will spend the first 45 minutes and final 15 minutes doing roll-call and debriefing. Officer, date, and beat-assignment fixed effects are included.

Figure A.4: Effect on Stops Conducted, Split by Day of Week of First Shift



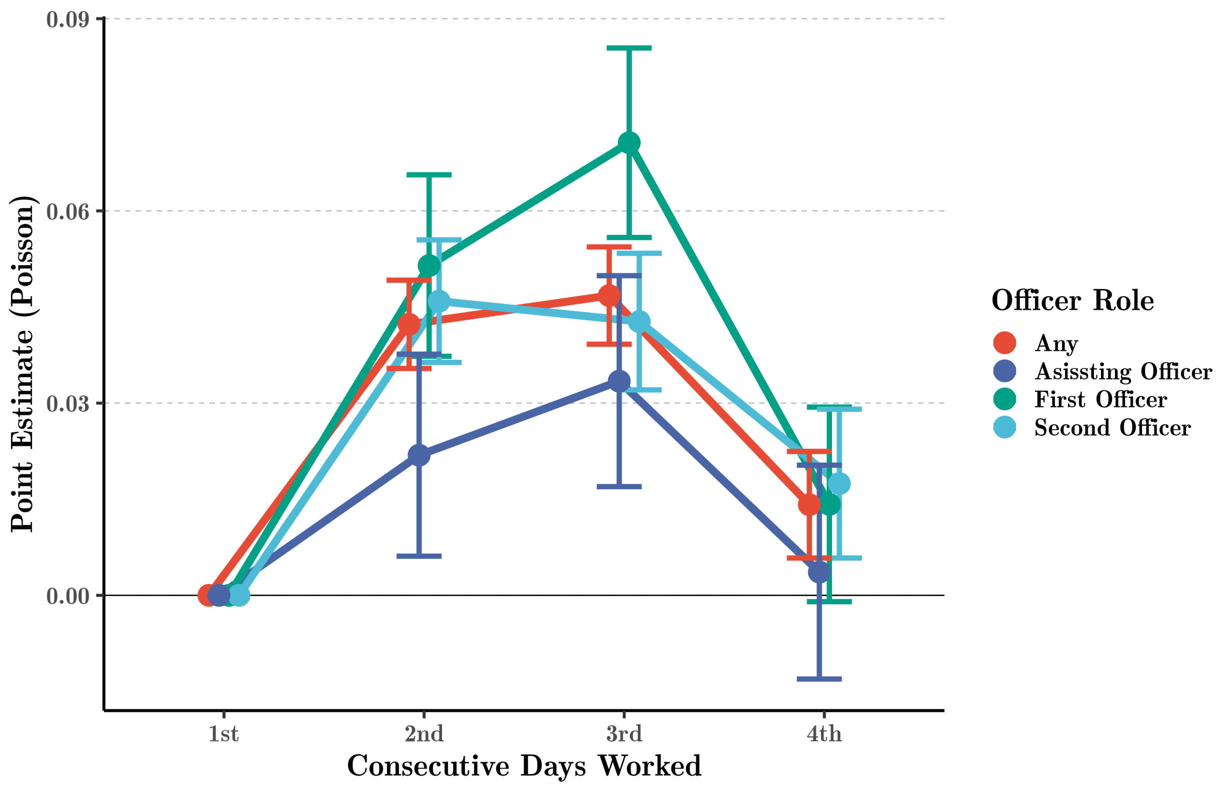
Note(s): This figure depicts a single regression where treatment effect for days 2 to 4 are interacted with an indicator variable based on the weekday of the first day of their shift spell. Also included is an un-interacted indicator variable for each day of the week that shift spell starts. That is, all estimates are relative to a shift spells first day conditional on starting on the same weekday.

Figure A.5: Effect on Force Reported, Split by Day of Week of First Shift



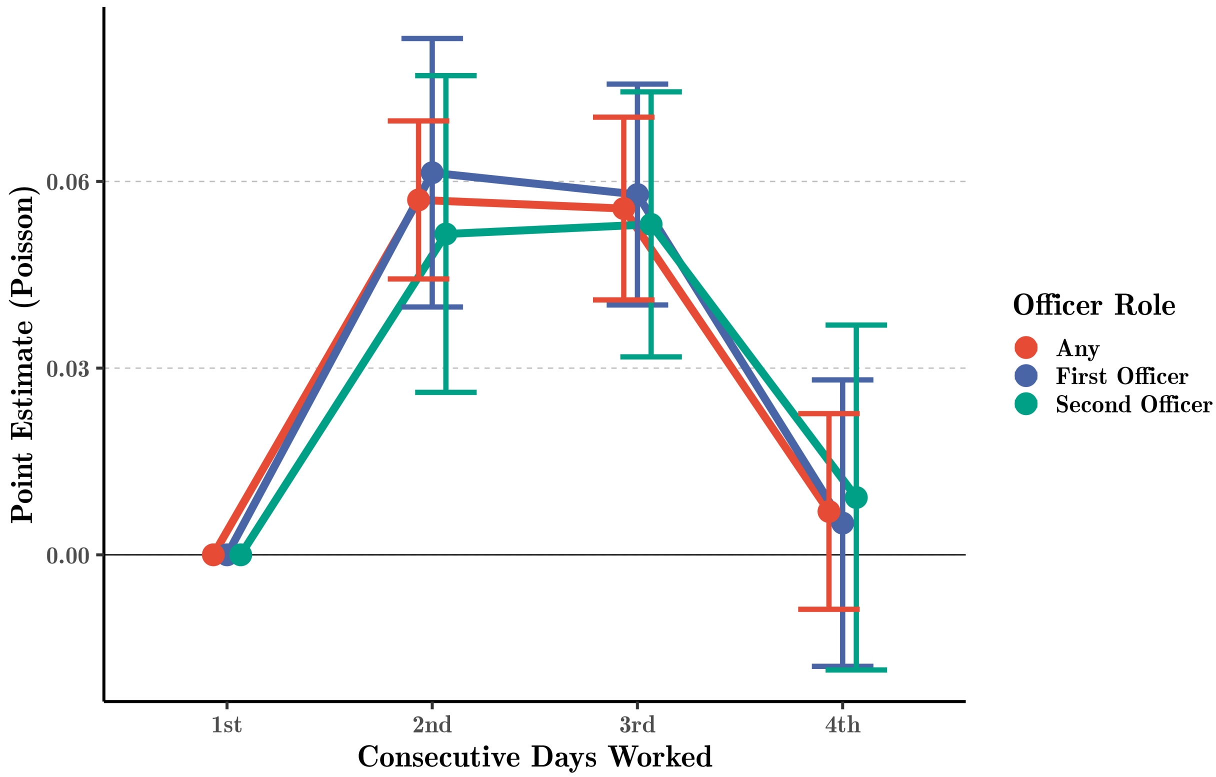
Note(s): This figure depicts a single regression where treatment effect for days 2 to 4 are interacted with an indicator variable based on the weekday of the first day of their shift spell. Also included is an un-interacted indicator variable for each day of the week that shift spell starts. That is, all estimates are relative to a shift spells first day conditional on starting on the same weekday.

Figure A.6: Relationship Between Days Worked and Arrests by Role



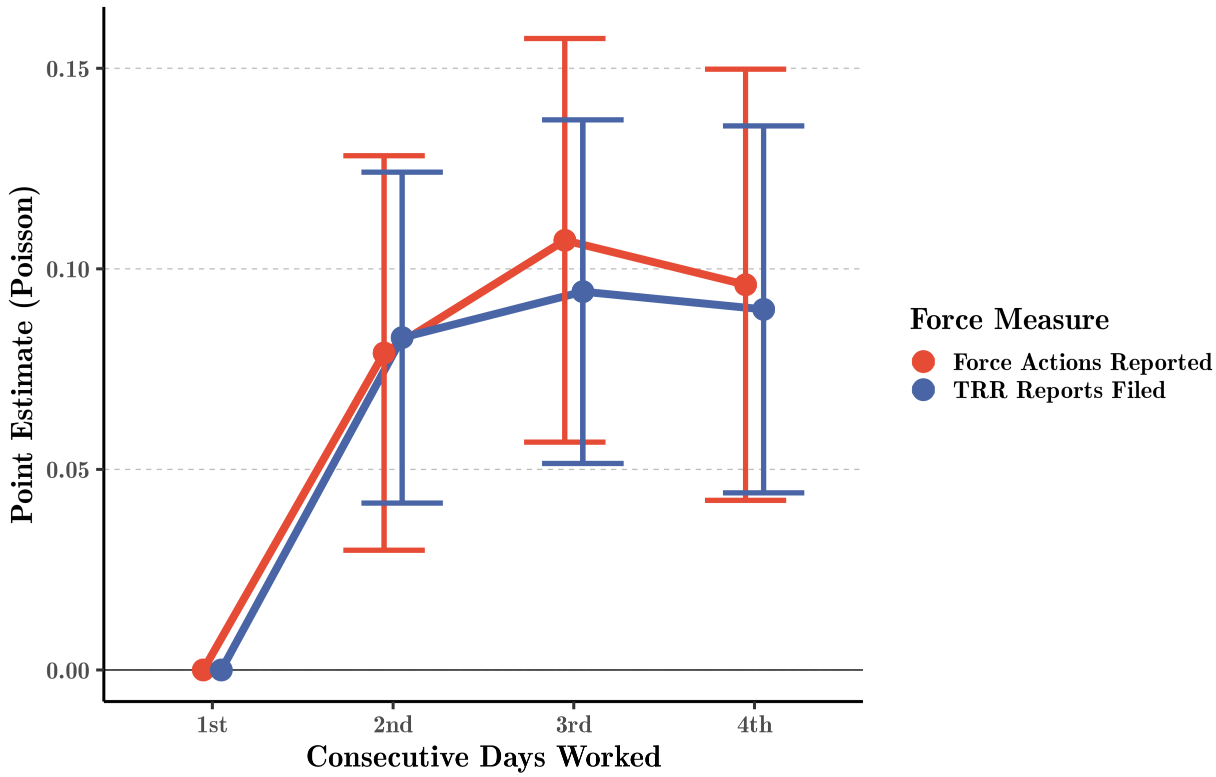
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Officer, date, and beat-assignment fixed effects are included. The outcome variable is the count of arrests of the specified role at the officer-day level. All arrests include a first officer but optionally contain a second officer and any number of assisting officers.

Figure A.7: Relationship Between Days Worked and Stops by Role



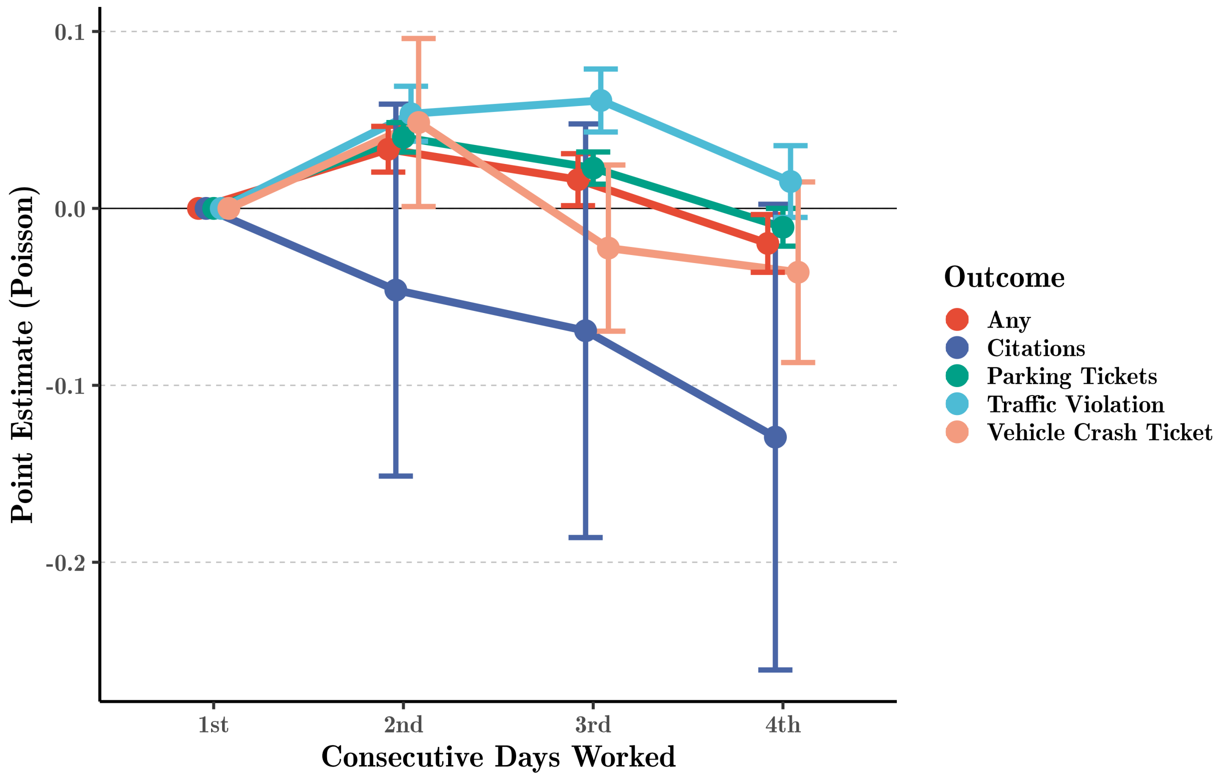
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Officer, date, and beat-assignment fixed effects are included. The outcome variable is the count of stops of the specified role at the officer-day level. All stops include a first officer but optionally contain a second officer.

Figure A.8: Relationship Between Days Worked and Force Report Measures



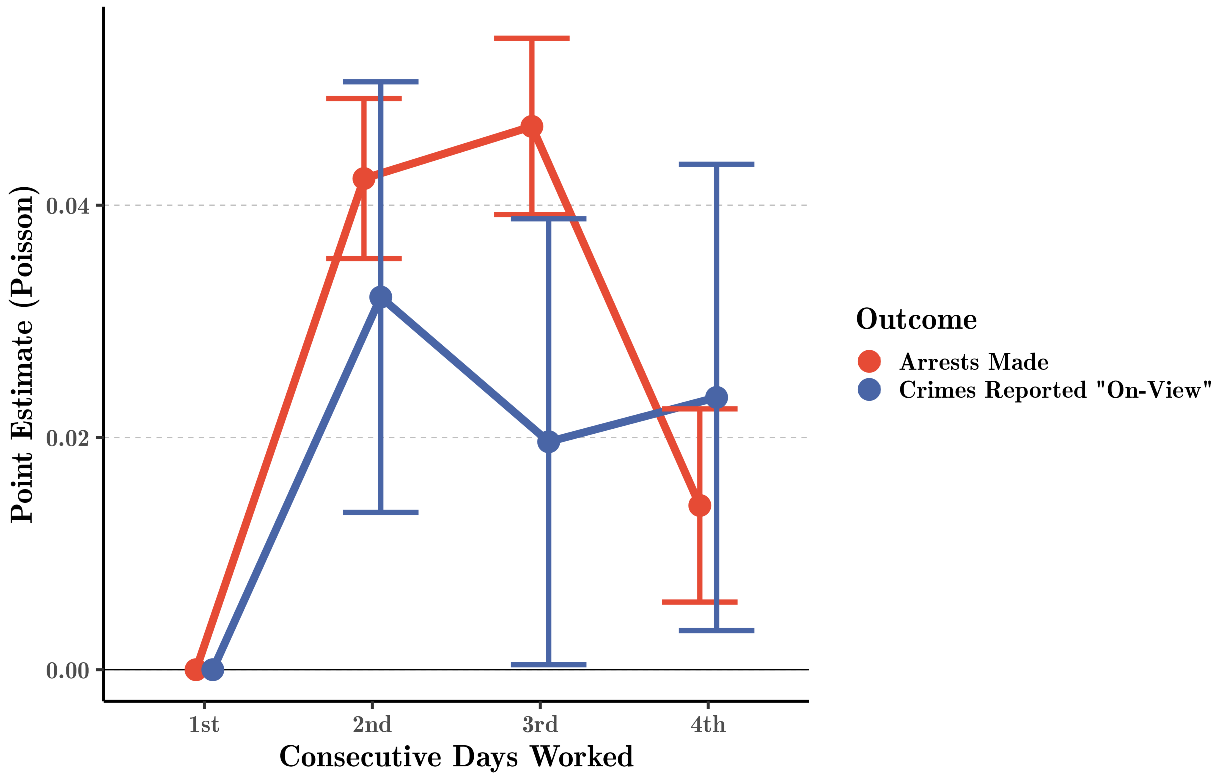
Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Officer, date, and beat-assignment fixed effects are included. *TRR Reports Filed* measures the number of TRR use-of-force reports filed by officers at the officer-day level. *Force Actions Reported* measures the number of reported actions originating from TRR use-of-force reports at the officer-day level. Force actions range from minor (e.g. handcuffing) to extreme (e.g. firearm discharge). Each TRR use-of-force report contains on average 2.7 force actions.

Figure A.9: Relationship Between Days Worked and Citations, Tickets, and Other Violations



Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Officer, date, and beat-assignment fixed effects are included. The outcome variable is the count of outcomes at the officer-day level.

Figure A.10: Relationship Between Days Worked and Arrests Made Versus Crimes “On-View”



Note(s): Estimated with Poisson with standard errors clustered at the officer level and 95% confidence intervals shown. Officer, date, and beat-assignment fixed effects are included. “On-View” crimes are those observed by a police officer that are not a result of a (911) call for service. “On-View” crimes do not necessarily result in an arrest.

Table A.1: Poisson Estimates for *Day Worked Number* and Being Assigned Police Car

	Indicator For 'Assigned Vehicle'
	(1)
Day Worked Number	
$\times$ Day 1	-
$\times$ Day 2	0.001***
	(0.000)
$\times$ Day 3	0.001***
	(0.000)
$\times$ Day 4	0.001**
	(0.000)
Mean of Dependent Variable	0.839
Observations	5460576

Note:
* p < 0.1, ** p < 0.05, *** p < 0.01. Observation level is officer-day and spans 01/2014 to 12/2022. The dependent variable is an indicator variable equal to 1 if an officer is assigned a vehicle. Standard errors are clustered at the individual level.

Figure A.11: Cancellation Notice Sent on 12/06/2021

THIS MESSAGE PROVIDES CORRECTIONS OR ADDITIONS TO MESSAGE #274782.

REFERENCE # 274783

RDO CANCELLATION

06-DEC-2021 17:32

GENERAL MESSAGE

Distribution Method:
- Archive
- CPD Intranet Home Page
- Unit Inbox
- Faxed
- Email

Select distribution list

To: ALL UNITS

From: MARZULLO, VICTORIA J
SERGEANT OF POLICE
140 - OFFICE OF THE FIRST DEPUTY SUPERINTENDENT (OFDS)

Telephone No.:312-745-6200

On Behalf Of: ERIC M. CARTER
FIRST DEPUTY SUPERINTENDENT
140 - OFFICE OF THE FIRST DEPUTY SUPERINTENDENT (OFDS)
312-745-6200

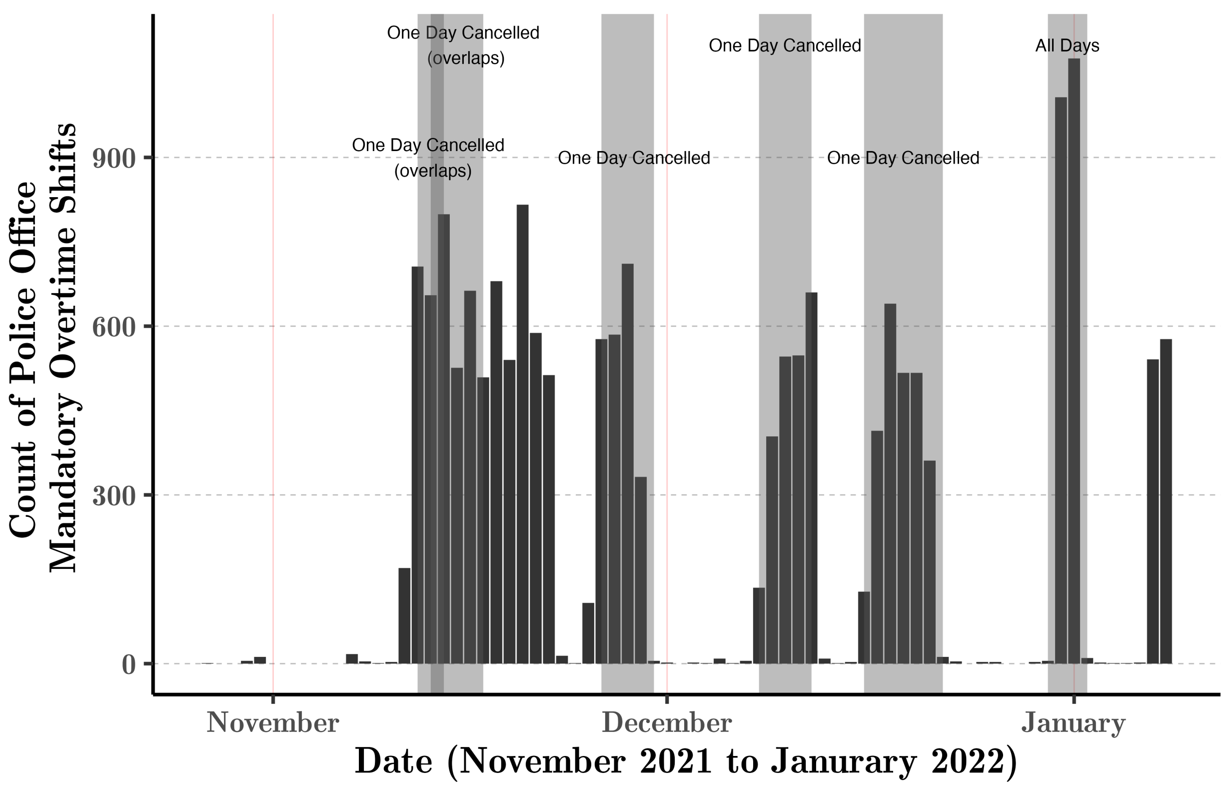
Message: Beginning 1st Watch 09-DEC-21 (Wednesday night for Thursday) all sworn, full duty members will have ONE RDO cancelled; the Department will return to normal operations with regular days off effective 2nd watch 13-DEC-21. The member's first RDO will be cancelled. PSHQ and Training Support Group (TSG) personnel will have one of their two days off cancelled, assignment rosters are forthcoming for which RDO will be cancelled. Sworn CPD members are further reminded the use of elective time remains restricted. The use of elective time will require prior approval from a Deputy Chief or above within the requesting member's chain of command. Members should continue to watch the Administrative Message Center for updates.

Attachments:

WARNING: This message is intended only for the use of the individual or agency to which it is addressed and may contain information that is confidential and/or exempt from disclosure under applicable law. If you have received this communication in error, please notify us immediately by telephone and destroy the original. Any unauthorized copying or dissemination of this communication is prohibited.

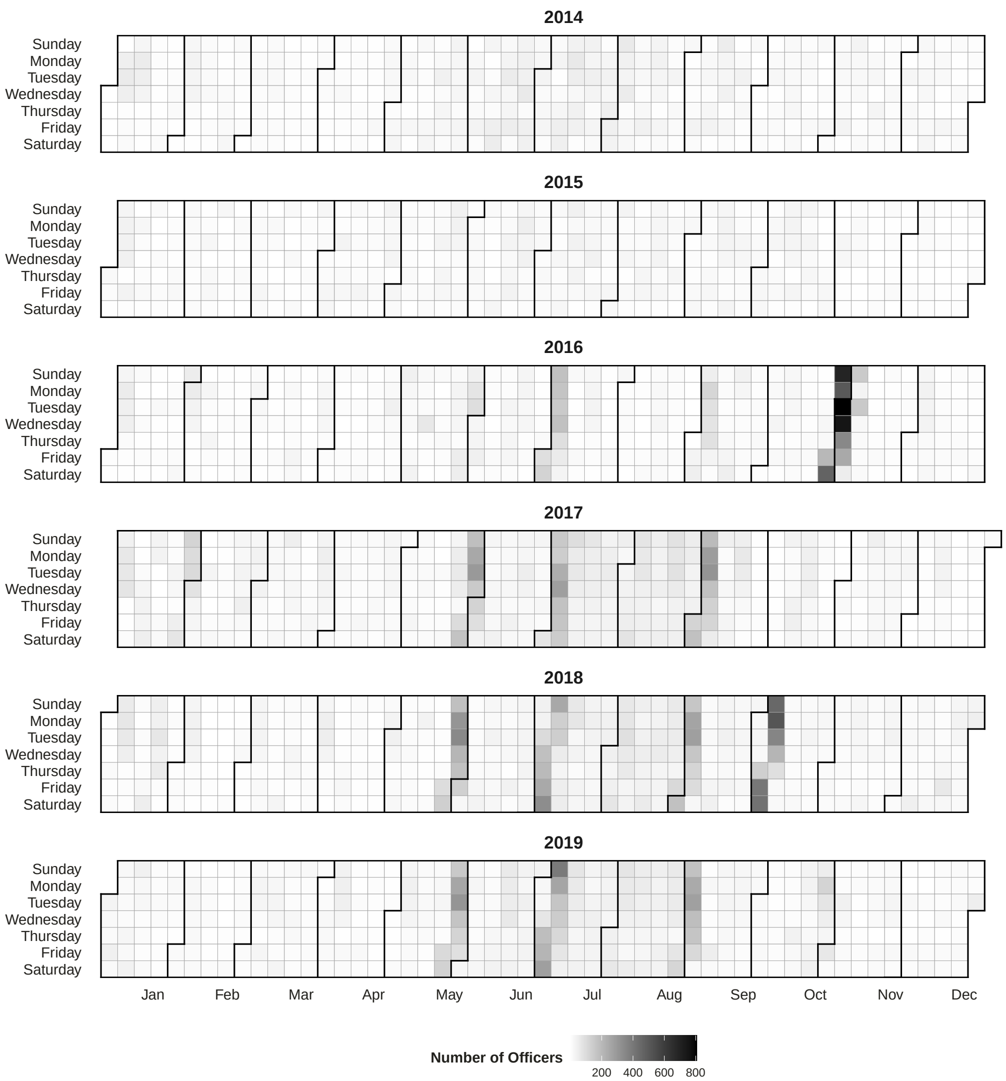
CITY OF CHICAGO / DEPARTMENT OF POLICE 3510 SOUTH MICHIGAN AVENUE CHICAGO, IL 60653

Figure A.12: Count of Mandatory Overtime, 12/2021



Note(s): This figure depicts the count of mandatory overtime shifts worked by beat officers between November and December of 2021. The shaded regions indicate the time period that days off were cancelled, and the text indicates the number of days off that were cancelled per officer.

Figure A.13: Frequency of Shifts with *Day Worked Number* > 4



Note(s): This figure plots the frequency of 'extra' shifts for officers. Any shift that is worked outside of an officer 4-day schedule is counted.