DO POLICE GO TO PLACES WITH MORE CRIME? A SPATIAL AND TEMPORAL EXAMINATION OF POLICE PROACTIVITY

by

Xiaoyun Wu
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DEDICATION

This is dedicated to my parents.

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LIST OF ABBREVIATIONS

Closed-circuit television ....CCTV
Jacksonville Sheriff's Office..JSO
Socioeconomic status..SES
Spatial Point Pattern Test.. SPPT
The United States .... US

ABSTRACT

DO POLICE GO TO PLACES WITH MORE CRIME? A SPATIAL AND TEMPORAL EXAMINATION OF POLICE PROACTIVITY

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George Mason University, 2015

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Over the last four decades, research has shown that police officers can reduce and prevent crime when they employ proactive, problem-solving, and place-based strategies. However, whether this research has translated into daily police activity is seldom examined. Are police being proactive when not answering calls for service? Do they target that proactivity in places that need it the most? Using calls for service data in a progressive police agency, the authors examine both the spatial and temporal relationship between proactive activity by officers and concentrations of crime using multiple methods, including Andresen's Spatial Point Pattern Test. Results suggest that police in Jacksonville are highly proactive, place-based, and micro-scaled in allocating their resource. They spent a large proportion of their resources conducting proactive work in accordance with the spatial distribution of crime, and they specifically concentrated significant proactive resources in the most crime-ridden areas, making the relationship an

increasing curvilinear one between police proactive work and crime at places. More specifically, each crime at a micro place is related to around 40 additional minutes of police proactive work there, the figure of which becomes even higher at places with high enough crime.

CHAPTER ONE: INTRODUCTION

The police have experienced great reform in their occupational role and in their strategies in controlling crime over the last few decades, with the purpose of advancing an effective, efficient, and legitimate policing model. In the 1930s in order to eliminate the dominating political influence over policing, the police started developing the standard "professional" model- that emphasizing random patrol, rapid response to 911 call, and investigation of serious crime as three leading strategies (Braga & Weisburd, 2010). While such strategies succeeded in separating the police from politics, crime during the subsequent decades continued to be high.

Criticism emerged as early as the mid-1970s pointing out that the standard practices were wasteful and had little impact on crime or on fear of crime in American communities (Martinson Report, 1974; Kelling et al, 1974). As a result, new perspectives on why crime occurs and new strategies on controlling crime started to develop during this period. Innovative policing strategies such as hot spot policing, community policing, and problem-oriented policing were created and demonstrated to be promising. By systematically synthesizing and reviewing evaluations on those strategies over time, studies reached a common conclusion that police can be effective in controlling crime, and they can be more effective employing proactive, specific, and place-based strategies like hot spots policing than reactive, general, and individual-based ones like random

patrol (Lum, Koper, & Telep, 2011; Weisburd & Eck, 2004). In particular, findings from

evaluation research continue to find that proactive strategies on places and people that

have high risk of crime, not reactively responding to 911 calls, can prevent and reduce

crime.

The question for policing—and the focus on this thesis—is whether police are

indeed proactive and place-based. Police activity on street is a complex issue to fully

understand. Most of all, patrol officers enjoy wide discretion and there is great variability

in their allocation and employment of resource. This variability speaks to a number of

aspects including the components of police work (e.g., incidents handling, investigation

or follow up, service rendering, administrative work, and personal issue), the type of

activity or tactic (e.g., simple patrolling, problem-solving, law enforcement, and

community policing), the specific problems occurred and being targeted (e.g., disorder,

narcotic activity, violent or property offenses, etc.), and also the numerous locations and

places police choose to allocate their resource. While some of these activities accord with

evidence, for example, patrolling at the most crime-ridden locations, others are less so

especially when police allocate their resource at places in a way that is not informed by

crime distribution. Given the importance of police activity and such wide variability, it is

critical to understand whether and to what extent police are following research evidence

in field, so as to better translate research into practice.

As important as it is, however, whether police work accord with evidence is

seldom examined. As James Burch (2015) stated, while supporting evidence-based

practice is a top priority for practitioners nowadays, "questions remain as to what extent

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these agencies and their operational counterpart agencies are truly embracing evidence-based practices" (p. 2). In particular, are police officers being proactive and preventive on streets? Where specifically do police officers go and how long do they stay at places when they are not responding to call for service? Are such decisions impacted by crime rates at place? That constitutes the context and focus of the current study.

Specifically, by examining where and how long police choose to be proactive, this study seeks to answer two questions. First, do police tend to concentrate their proactive behavior in places with high levels of crime? And if so, do they do this generally, at larger spatial units, or more specifically, at smaller units? Consistent spatial patterns between police proactivity (proactive activity) and crime would be expected for a proactive and place-based policing style, especially if that proactivity is systematically targeted at specific crime concentrations at micro units. Second, do higher levels of crime at places tend to lead to higher levels of time spent by the police carrying out proactive activities? The second question incorporates the temporal component in order to understand in further details the proactive allocation of time resource by police and how that is influenced by crime rate at place.

To explore these two questions, I examined the call for service data from Jacksonville, Florida. I used the Spatial Point Pattern Test in comparing the spatial pattern of police proactive activities with that of crime across the city. Then I employed regression models to test the correlation between the level of proactive time patrol officers spent at place and the level of crime there. I concluded with a discussion about the implications of the study, and what future efforts might focus on.

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CHAPTER TWO: LITERATURE ANALYSIS

In general, the police are hypothesized to control crime through two types of mechanisms (see Nagin, 2013; Nagin, Solow and Lum, 2015). First, by apprehending wrongdoers and moving them off the streets, police act to reduce the amount of what Cohen and Felson (1979) call motivated offenders and thus reduce crime theoretically. When doing so, police are acting as apprehension agent based on the function of incapacitation (Nagin, 2013; Nagin, Solow and Lum, 2015). The apprehension role of the police is reactive in nature, and for the most part is triggered by the occurrence of crime and by a citizen calling the police. Second, police can reduce crime by serving as capable guardians (Cohen and Felson, 1979), reducing the opportunities at places and thus preventing crime from occurring in the first place. When acting in this role, police are functioning as what Nagin (2013) labels, "sentinels." As opposite to the apprehension role, sentinel role is proactive in nature. Police do not have to wait until the occurrence of crime in order to perform the role of guardian.

Although police do act in proactive ways, knowledge gathered in the last four decades have suggested that the police are often more aligned with the first type of role, focusing most of their efforts to reacting to crime (Braga and Weisburd, 2010; Lum and Nagin, forthcoming; Nagin, Solow and Lum, 2015; Weisburd, 2008; Weisburd and Eck, 2004). However, as Nagin, Solow and Lum (2015) argue, police would have failed once

an arrest is made because "police effectiveness in their role as apprehension agents is an outgrowth of a failure in their role as sentinels to have successfully prevented the crime from happening in the first place" (p. 84). Hence, they reach an important conclusion that police should rely more on their proactive sentinel role, by which they are able to reduce arrest and crime at the same time, and thus reduce also the high prison cost. More specifically, work by those studying the spatial distribution of crime (See Brantingham and Brantingham, 1993; Braga and Weisburd, 2010; Eck and Weisburd, 1995; Sherman et al, 1989; Sherman and Weisburd, 1995; Weisburd and Mazerolle, 2000) as well as those evaluating police activity have added that not only should police be proactive, but they should be proactive at places where crime (and opportunities for crime) occur.

Deterrence

One of the most critical theories underlying police proactivity is deterrence theory. Deterrence theory, originated from the work of the classic school (Beccaria 1764; Bentham 1789), asserts that people make rational decisions about whether or not to commit crime (Nagin, 1998). They calculate the benefit and cost associated with crime based on information available and will offend when the benefit overweighs the cost. The content of benefit and cost ranges widely, including not only tangible materials and formal sanction, but also intangible benefit like honor or informal cost like shame. Criminal justice system, as the most serious and the final resort, deter people from committing crime mostly through the formal threat of punishment. There are basically three dimensions of the deterrence of punishment, the severity of punishment, the certainty of punishment, and the celerity of punishment (Nagin, 1998; 2013).

The evidence consistently points to the effectiveness of the certainty, rather than the severity of punishment that creates a deterrent effect on criminality. After Nagin (1978) found out that the previously assumed negative impact of criminal sanctions on crime is flawed because of the wrong direction of causality, he has developed a line of researches that provide evidence for punishment certainty over severity (See Durlauf and Nagin, 2011; Nagin 1978; 1998; 2013). Take Durlauf and Nagin (2011) for example, they systematically reviewed the empirical evidence of deterrence-based policies and found that first, increasing lengthy prison sentences has a modest deterrence at best; second, effective deployment of police increases the perceived apprehension risk and has substantial deterrent effects; and third, there is little evidence suggesting the specific deterrent effect resulted from the experience of imprisonment. At the end, they concluded that by shifting the focus from severity to certainty of punishment, the system will be able to not only reduce crime rate, but also reduce imprisonment and its associated prison cost simultaneously.

Police holds a critical role under the certainty-based mechanism. Most of all, in order for an offender to be deterred by the certainty of punishment, whatever the punishment is, he or she has to first perceive a risk of apprehension. As Nagin (2013) argued, "successful passage through all of these stages (from being charged to being sentenced) is far from certain. The most important set of actors affecting certainty is the police: without detection and apprehension, there is no possibility of conviction or punishment" (p. 42). Nagin, Solow and Lum (2015) again strengthened, "the certainty of punishment is the product of a series of conditional probabilities—the probability of

apprehension given commission of crime, the probability of being charged given apprehension, the probability of conviction given charge, and the probability of various formal sanctions given conviction", but "support for the deterrent effect of certainty of punishment…pertains almost exclusively to the certainty of apprehension" (p. 75). In short, it is through the risk at the very outset of entering into the criminal justice process-- the risk of apprehension--that offenders perceive the certainty of punishment. Police proactive work, as a visible indicator of apprehension risk, is thus critical for police to deter while at the same time keeping the actual apprehension minimal.

Place-Based Proactive Policing

The second line of research complementing police proactivity is related to studies of criminal context and the geographic distribution of crime. While it is clear from above that police should rely more on their proactive function in controlling crime, it is less so about where they should conduct proactive work and how they should translate proactive policing into specific tactics. The place-based theories, or opportunities theories, and later empirical works supplement such information by focusing on the contextual elements of crime incidents.

The interest of scholars in the criminal context has been growing ever since the 1970s when traditional crime prevention strategies targeting individuals were being criticized as not effective. Clarke (1980; 1997) develops opportunity theory asserting that people make decisions about whether or not to offend, taking into account not only the benefit and cost of offending, but also the opportunity structure around the choice. Essentially it is the opportunity structure presented in the environment, rather than the

disposition or individual per se, that determines the nature and the distribution of crime. As a result, crime can be most effectively prevented by proactively blocking the opportunity presented in the context through situational crime prevention, for example, installing CCTV in the retail store to reduce shoplifting, or allocating police officers proactively at places with abundant opportunities.

At the same time, Cohen and Felson (1979) developed routine activity theory arguing that crime occurs because of the convergence of motivated offender, suitable target, and lack of guardianship. Modern interpretation divides it into two branches, routine activity theory of lifestyle (Cohen & Felson, 1979; Felson, 1994; Osgood et al, 1996) and routine activity theory at place (Sherman et al, 1989; Sherman & Weisburd, 1995). Lifestyle routine activity theory asserts that the convergence of the three factors is determined by the rhythm, tempo, and timing of everyday life, which in turn is impacted by the macro social forces like industrialization. In this sense, lifestyle routine activity explains crime problem primarily from the macro perspective. Routine activity theory also implies place. The convergence of the three factors creates crime. The concentration of the convergence at place would, then, create concentrated crime at places (Sherman et al, 1989). In this sense, routine activity theory underlies later hot spot studies.

Sherman et al (1989) noticed that crime is not evenly distributed across the city. Over half of the calls for service were produced by around 3% of addresses, suggesting a substantial concentration of crime at micro places called hot spots. By examining the longitudinal data in Seattle over a 16-year period, Weisburd et al (2004) and Weisburd et al (2012) found that not only crime concentrates at micro places, crime opportunities

including motivated offender, suitable target, and lack of guardians, and social disorganizational factors such as SES reflected by property value and public housing concentrate at micro places as well. More importantly, such concentrations are stable over a long period of time, implicating great crime prevention benefits by proactively focusing police resource on micro crime hot spots.

Empirical evidence on hot spot policing provided strong support to the proactive and place-based police patrol strategy. Sherman and Weisburd (1995) conducted a randomized controlled trial on hot spot policing in Minneapolis as a response to the Kansas City Preventive Patrol Experiment, which dominated the policing field for a long time with the finding that increasing the dosage of police presence produced no statistical significant effects on street crime. Sherman and Weisburd were not convinced by the Kansas study primarily because the experiment was done in large patrol beats, which diluted available dosage too much to expect a reasonable impact. They focused patrol dosage on micro hot spots in Minneapolis and found that intensive police presence at those places produced modest general deterrent effect on crime and impressive deterrence on disorder. Based on the same set of data, Koper (1995) found that the optimal time for police to stay at a hot spot is around 15 minutes in order to maximize their deterrence. The success of Minneapolis study encouraged more studies to test the utility of hot spot policing later on, including hot spots of street-level drug market (Weisburd & Green, 1995), gun violent crime(Sherman & Rogan, 1995b), violent crime (Braga et al, 1999), crime and disorder hot spots (Braga &Bond, 2008), and so forth. Systematical review and meta-analysis from Braga (2005; 2007; 2012) provided strong support that focusing

police efforts at high activity crime places can be effective in preventing crime. Evidence to date seems to be consistent that police can be effective by being proactive as well as place-based in allocating their resources.

Proactive and place-based policing strategies can be translated into many types of specific tactics. Police presence, as one of the most important forms, emphasizes police officers being present at problematic places, by which they are able to increase the guardian level at crime hot spots and block the abundant opportunities there. While basically all policing strategies involves police presence, some rely more on police being present than others. In this category includes tactics like directed patrol (Sherman and Rogan, 1995b; Sherman and Weisburd, 1995), stationary targeted presence (Lawton, Taylor, and Luongo, 2005), foot patrol (Ratcliffe, Taniguchi, Groff, and Wood, 2011), and patrol on car, all of which have been demonstrated to be effective when combined with hot spot approach to certain extents.

The second type of proactive and place-based strategy speaks to problem-oriented policing. Problem-oriented policing includes a set of police proactive tactics that aim at cooperating with communities and solving persistent problems by identifying, analyzing, and responding to the underlying circumstances that create incidents (Eck and Spelman, 1987). Depending on the problems existed in a place, problem-oriented policing could contain different tactics including situational crime prevention, order maintenance enforcement, social interventions, and various other efforts that emphasize the use of non-law enforcement solutions as well as traditional responses (Groff et al, 2015; Taylor et al, 2011). It has been shown as effective especially when combined with hot spot

policing for different types of problems (See Braga and Bond, 2008; Clarke and Eck, 2005; Eck and Spelman, 1987; Taylor, Koper, and Woods, 2011).

Proactive and place-based strategy can also combine traditional crime prevention elements such as targeting at high-risk individuals. In a randomized controlled trial, Groff et al (2015) find substantial crime reduction benefits of offender-focused policing that is employed at crime hot spots. Such intervention, when combined with place-based element and designed intelligently, can be also efficient and less intrusive for law-abiding citizens (Groff et al, 2015). In sum, evidence to date has provided a series of effective proactive and place-based strategies for practitioners to effectively prevent crime. While understanding which specific type of activity is most effective is beyond the scope of this article, it is clear from the compelling evidence that with a proactive and place-based approach, police can be most effective and efficient in tackling crime.

Are Police Place-Based and Proactive?
Knowing that police can be effective when they allocate their resource in a proactive and place-based way does not mean that police are doing so on streets. In fact, limited existing evidence seem to suggest that proactive and place-based practices in police agencies, even if exist, tend to be general or superficial. Weisburd (2008) discussed how place-based approach is perceived and employed among practitioners. As he argued, while places and place-based approaches like crime mapping have indeed always been components in policing, they were not perceived or utilized in a fundamental way as expected. "Place-based policing demands a fundamental change in the structure of police efforts to do something about crime and other community problems" (p. 10), for

example, change the way that data is collected in field from offender-centered to place-centered. Police generally have been doing better in collecting place-related information over the last decade, but such information collected in most jurisdiction seldom go beyond a simple address and the address locator is often inaccurate (Weisburd, 2008).

The translation of research in policing to street-level practice is another important issue (Lum, 2009; Lum et al, 2012). Without an adequate translation, evaluation, and feedback system, it is hard to systematically internalize a place-based proactive approach into the daily works of patrol officers. They do not necessarily realize the importance of police proactive function, nor do they often receive place-based directions in such a detailed way that shows, for example, how many resources they are expected to allocate at specific locations and how crime rate at places is sensitively impacted by their activities. They might be intuitively aware that some places have more crime than others, but such awareness is seldom systematic, nor is it usually based on real-time data. For example, Ratcliffe and McCullagh (2001) compared the hot spots identified by police officers and through empirical data, and found that police tend not to accurately identify where hot spots are, suggesting a lack of adequate translation and perhaps also an insufficient level of receptivity to researches among practitioners.

Indeed, for patrol officer, it is much more common to be driven by responding to 911 calls, and then relying on their discretion during "non-committed" time periods (when they are not responding to calls for service) (Famega, 2005). Even though place-based patrolling strategies have been consistently supported by studies as being more effective, the old pattern continues to be followed in many police agencies (Weisburd,

2008). As raised by a number of scholars (see Groff et al., 2014; Lum, 2009; Lum and Koper, 2012; Sherman et al., 2014; Weisburd et al., forthcoming), the key issue now might not be what approach can work anymore, but rather whether police officers are utilizing their resource and doing what works empirically.

It is the purpose of this paper to also understand what patrol officers are doing on streets and how they spend their shifts. As suggested by a systematic review of police activity on street by Famega (2005), police generally have large portions of downtime (on average 75% of the shift) when they are not occupied by call for service. During this part of time, police might be doing various different activities including routine preventive patrol, self-initiated activities, administrative issues, investigation and follow-ups, attending court, service related issue, personal activities, or they might be doing nothing but waiting for the next incident to occur. Wide discretion exists as to how police spend the free part of their shifts when they are not responding to citizen calls. Moreover, considering also the numerous problems police need to tackle each day and the innumerable locations and places police could patrol, they do have strikingly great options in choosing how they allocate their time and where they target.

It is not unusual for police agency to try to better manage and make use of police free time. Police might be directed to perform specific tactics as deemed necessary by the agency in tackling crime. Most commonly, they might be directed to conduct patrol in a certain area or conduct "crackdown" and enforce law for specific type of problem (Sherman, 1990). Or, they could be required to work with local communities or social organizations and resolve underlying problems that lead to crime. But to date it is unclear

to what extent police agencies make such endeavors. Nor is there firm evidence regarding whether and to what extent research evidence is employed in making such deployment.

In this study, I examined police administrative data to understand what police are doing with their limited resources on street and whether that accords with existing evidence. I investigated specifically where police patrol, and how much time they spend at crime hot spots. Even though specific activity of police is not examined, we can understand the geographic and temporal behaviors of patrol officers and how those are related to crime.

More specifically, based on calls for service data from the Jacksonville Sheriff's Office for the year of 2013, the study investigates primarily two questions

(1) Does police proactivity tend to correspond with where crime concentrates?

(2) Do police tend to spend more time at places with high levels of crime as measured by calls for service?

If the police department is generally following the proactive and place-based logic of police patrol, consistent spatial patterns will be observed between police proactivity and crime rate. If the consistency is reflected at very micro level, it would indicate that the department is much more attuned to targeting crime problems at specific places, making the agency more aligned with the research. The same logic can be applied to the second question. A general consistent temporal correlation between crime rate and police proactivity at places would suggest a place-based orientation for the police department in allocating police resource. However, a second speculation raises the possibility that when police have spent most of their time reacting to crime calls for service at places, they

might have less time to do proactive activities there. As such, three possibilities of how police allocate their proactive resources are proposed based on the research questions above.

(1). Probability one: Police proactivity does not correspond with where crime concentrates because police officers need to cover other parts of the city that received less service due to the small amount of crime there. Rather than place-based allocation of resource, or allocation based on needs, the police department emphasizes an average pattern for resource allocation. Probability one is not much likely to be the case because as shown in the literature review, police department is generally more concerned with crime control than they are with the simple equal allocation of resource (Non-corresponding relationship).

(2). Probability 2: Police proactivity generally correspond with crime rate in terms of the spatial distribution as a result of a general place-based patrol pattern, suggesting that police department is concerned about the geographical distribution of crime and is committed to allocate resource correspondently. Accordingly, the amount of time police spent at places proactively also corresponds with the level of crime rate there (Positive linear relationship).

(3). Probability 3: Police proactivity generally correspond with crime rate in terms of the spatial distribution as a result of a general place-based patrol pattern, suggesting that police department is concerned about the geographical distribution of crime and is committed to allocating resource correspondently. However, because large amount of time have already been consumed by reacting to the high levels of calls for service at

those locations, police are left with fewer time to conduct proactivity there. As a result, the amount of time spent proactively at places would increase first, and then decrease once above a certain level of crime rate at places. The curvilinear relationship between times spent proactively and reactively at places would also suggest an inadequacy of resource at places with high levels of crime (Increasing and then decreasing relationship).

CHAPTER THREE: METHODOLOGY

Different methods are employed in exploring each of the questions. For the first question, a Spatial Point Pattern Test is performed to test the similarity of spatial patterns between police proactive behavior and crime. For the second question, simple regression models are employed in order to investigate the relationship between the amount of time resources police spent at places and crime level there.

Data

The data examined in the study is the call for service data in the city of Jacksonville, Florida for the year of 2013. Jacksonville Sheriff's Office (JSO) has a high level of commitment to the evidence-based policing. They set a Crime Analysis and Research and Development section within the department, focusing on turning data and information into better crime fighting strategy. This section is nationally recognized and has rich connection to the academia. In 2007, a randomized controlled experiment was conducted at Jacksonville to test the comparative effectiveness of directed patrol and problem-oriented policing approaches at hot spots of violent crime. The results suggested a larger and more lasting crime reduction for problem-oriented strategy than for directed patrol in violent hot spots (Taylor et al, 2011). Efforts were taken subsequently to incorporate and institutionalize the results into JSO's practices, suggesting a high level of commitment to evidence of the department. Hence, a generally high level of consistency

between police proactive activity and crime rate in terms of the spatial and temporal

distribution is expected under the current study.

Consistent with the evidence-based orientation in JSO, their call for service data

is recorded in a comprehensive and clear style. As reflected in the call for service data,

police generally have two types of working mechanism. The first mechanism is to answer

a call for service that is initiated by citizen, recorded in the data as "Phone" or "911".

This type of work is most common and is reactive in nature since police is responding to

citizen after a possible criminal incident has occurred. Another type of mechanism

happens when patrol officers spot a problem on scene and initiate a record themselves,

recorded in the administrative data as "MDT/OFFICER". Usually this type of work is

regarded as proactive in nature because the police are taking initiatives and no citizen

report is involved. In the year of 2013, police in Jacksonville created around 889,000

records in total, about 57% of which were initiated by citizen and 43% were initiated by

the police. The proportion suggests a relatively high level of police proactivity in

Jacksonville.

Other information related to the interest of this paper includes address and time

information. The address is recorded in a way indicating which street block the call was

initiated, for example, at 100 X Street. Based on the address information, I am able to

map out the geographic distributions for two sets of call for service data. Information

regarding timings is also recorded for each call. Specifically, the timing is recorded when

a call is made, when a police officer is dispatched, when he or she arrives, and when the

case is completed. The ranges between any two points of time are also calculated in the

data. For example, a variable named "arvcmpl" means the time range between the arrivals of the officer and the completion of the case, which suggests the amount of time that officer had stayed at the place where the problem occurs.

In order to examine the questions of interest, the data needs to be trimmed to exclude ineligible cases from the total. First of all, address information is missed in around 18% of the records, and time information is lacked in around 100 cases in specifically police-initiated calls. They are excluded because they lack either spatial or temporal information about crime or police proactive activities. Second, arrest was being made in 3.69% of the cases, with a number of approximately 32,800. They are excluded because the case completion time is significantly prolonged by the administrative process, during which the officer who made that arrest was no longer physically at the spot. Third, cases should be excluded if their addresses direct to places such as police station because police station is usually not the place where crime occurred. In order to do that, addresses with more than 1,000 cases through the year (the top 23 addresses) are manually checked. Three of top addresses are excluded as they direct to Jacksonville Sherriff's office or pretrial detention center. After excluding ineligible cases from the dataset, I ended up with around 285,400 records for calls initiated by police officers and around 400,400 records for calls initiated by citizens.

Next, in order to capture the real relationship between police proactive work and crime, decisions are made to exclude several types of calls that are not commonly regarded as crime or proactivity from the dataset and to only keep certain types of problems in the final analysis. In doing that, the problems in the record are categorized

into ten groups including violent crime, property offense, disorder incident, offense of drug and vice, suspicious incident, traffic related offense, investigation, administration, service, and non-crime. The first five types of problem are kept for citizen-initiated calls as they reflect real incidents that are commonly linked to crime. On the other hand, basically all the types of problems are kept for police initiated calls except for non-crime and administration (however, certain type of administration is kept such as "special assignment" as police could be conducting targeted proactive work like problem-solving in special assignment). In the end, around 251,700 cases for citizen initiated calls and 276,200 cases for police initiated calls are kept for further analysis.

In order for the above eligible cases to be geographically mapped, they need to firstly be geocoded. As suggested by Andresen (2011), "geocoding algorithms are not only inaccurate at times but are at risk of not locating all street addresses or street intersections for (criminal) incidents". One of the most common reasons behind is that the addresses might be improperly coded in the field as a nonexistent or an incomplete one. To address this issue and reduce the odds of detecting a biased pattern, Ratcliffe (2004) identified a minimum acceptable hit rate of 85 percent. For the current dataset, around 234,700 citizen-initiated cases (93.2%) and around 235,500 police-initiated cases (85.2%) are successfully geocoded for the final analysis, both of which have passed the minimum acceptable hit rate. Table 1 shows the number of cases excluded at each process and the number of cases kept for the final analysis for citizen-initiated calls and calls police initiated themselves.

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Table 1 Number of Cases Excluded

	Call for Service	
	Citizen-initiated	Police-initiated
Original Sample	505,200	383,700
Missing Address	87,100 (17.2%)	74,400 (19.4%)
Police Station, etc.	2,700 (0.5%)	12,700 (3.3%)
Missing Time	--	100
Arrest	14,100 (2.8%)	11,000 (2.9%)
Ineligible Categories	149,600 (29.6%)	9,200 (2.4%)
Unable to be Geo-coded	17,100 (3.4%)	40,800 (10.6%)
Final Sample	234,700 (46.5%)	235,500 (61.4%)

Measures

Three variables of interest are created and measured. First, crime rate is measured as call for service records initiated by citizen. The address in the record suggests where each specific crime occurred. Second, police proactivity is measured as records initiated by police officers. Similarly, the address suggests where each police proactivity happened. Each call is treated as one count for crime or police proactivity. Finally, the amount of time an officer spent proactively at a specific location is calculated as the period of time between police arrival and the completion of the case, which the original dataset has already calculated and specified as "arvcmpl".

Methods of analysis

Before using these measures to make analysis and answer the research questions, a critical decision has to be made with regard to the spatial unit of analysis. What should be the best spatial unit of analysis for studying crime has been under debate over decades (Weisburd et al 2009). As stated by Tita and Radil (2010), there is still no technical solution to address the choice of unit size and the associated level of aggregated

information. Hipp (2007) suggests that in deciding the best spatial unit of analysis, analysts should consider the outcome of interest or the structural predictors being used. In other words, what should be the best spatial unit of analysis is dependent on the question under examination and the variables being used in answering the question. Hence, different spatial units of analysis are employed for each of the two research questions in this paper, given different focused outcomes of interest and statistical programs employed in answering each of the two questions.

First, in exploring the spatial similarity between crime and police proactivity, three spatial units of analysis are employed including census tract, block group, and street block. This is aligned with the decision made by Andresen and Malleson (2011) in testing the spatial similarity between two sets of data at different geographical levels. They compared the spatial patterns between different types of crime at each of three levels: census tracts, dissemination areas, and street segments, in order to investigate the stability of crime pattern at different levels of place. In this study, block group and street block are employed rather than dissemination area and street segment because of the availability of the information. Figure 1 provides a representation of the scales for these three levels: one census tract in the central Jacksonville, five block groups and 160 streets blocks within that census tract. In the year of 2013, 174 census tracts, 490 block groups, and 14,904 street blocks were identified in the city of Jacksonville, according to the U.S. census data.
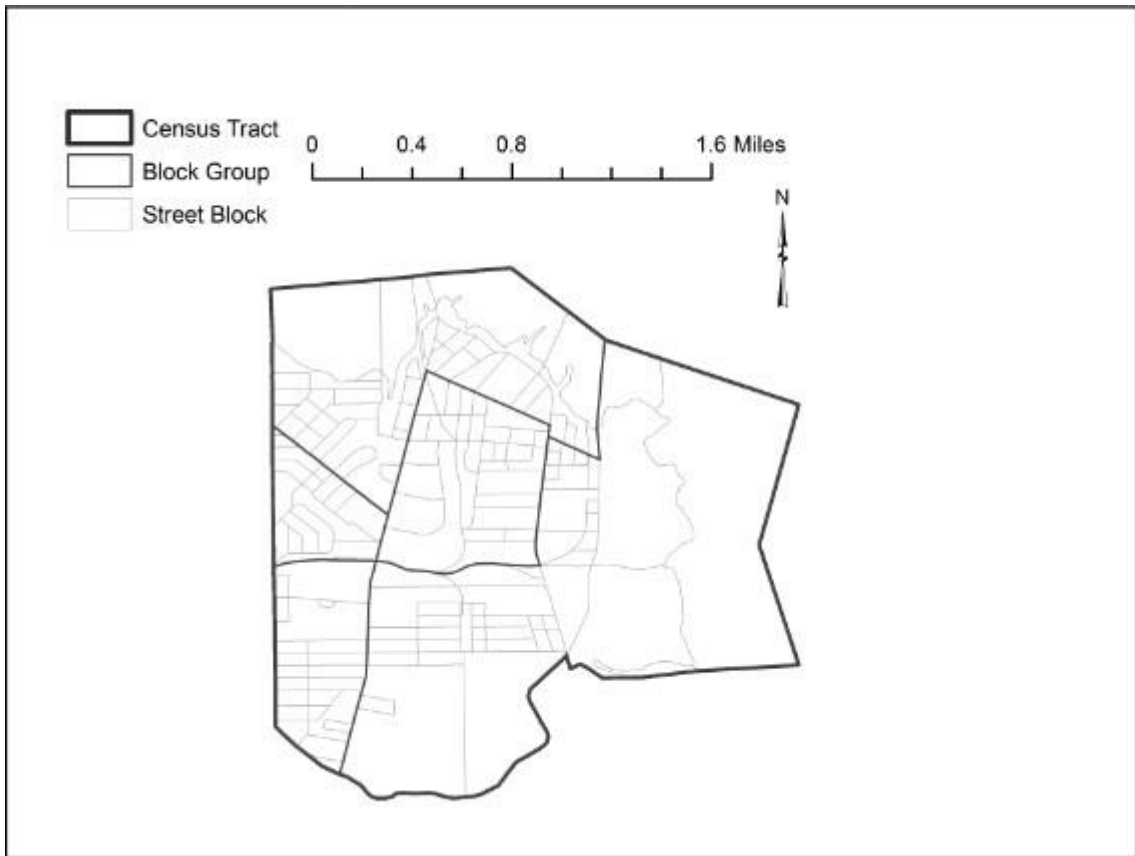
Figure 1 Spatial Unit of Analysis

Second, in order to investigate how much time police spent at areas with different levels of crime, grid-based approaches are employed, in which the lengths of cells are defined respectively as a mile, a half mile, and a quarter mile. I switched to the grid-based systems from the spatial units of analysis used in the first part for specific reasons. The statistical program used to investigate the correlation between crime and proactive time police allocated at places is regression model, which needs relatively large amount of cases in each unit to perform meaningful analysis. However, while a census tract or a block group is too large for the second part to understand the micro spatial and temporal

behavior of police, a street block is too small to contain enough number of cases for the regression model to produce reliable results. As a result, decisions are made to switch to grid-based approach in the second part.

Similar to the issue of the levels of place, what should be the best grid size in capturing the spatial pattern of interest is also a question up in air. While Massey (1997 as sited in Tita and Radil, 2010) argued that the larger the scale, the more likely the specific issue of interest can be obscured by processes operating at various other scales and in various other places, small-sized grid system is not necessarily always good because, for example, there might not be enough cases in each single small grid for meaningful analysis. To address this issue, three different sizes of grid are employed in regression models including a mile, a half mile, and a quarter mile. Jacksonville has an area of about 880 square miles, which can be divided into substantial number of cells for meaningful analysis.

The analysis program employed in the first part of the analysis is Spatial Point Pattern Test (SPPT) developed by Andresen (2009), to test and visualize to what extent the geographic patterns are similar between police proactivity and crime rate. SPPT is a test measuring the degree of similarity at the local level between two spatial point patterns, here between police proactivity pattern and crime pattern. It assigns each call in the geo-coded data as a point to a specific location, and then counts the number of points within a specific area for both base dataset (independent dataset) and test dataset (dependent dataset). It then randomly and repetitively takes 85% of the test dataset for 200 times, based on which it calculates the 95% confidence interval for the percentage of

test data that fall within each area. In this way, it is able to compare it with the percentage of the base data in that area and decide whether they are similar in each area. By comparing percentages instead of the number of the calls falling with each area, it controls the number of observation. As a result, police proactivity and crime rate at places are comparable under SPPT even though the total numbers of them are different.

The outputs of SPPT contain two parts. First, there is a global parameter, Index of Similarity (S), indicating the similarity between two sets of data in terms of their spatial patterns overall. S is calculated as the proportion of the places that have similar spatial patterns for two sets of data, with 0 indicating no similarity at all and 1 indicating a perfect similarity. The second part of the output is a shapefile containing both the background spatial polygon data and a newly generated column with values of -1, 0, or 1 indicating the S index for each of the specific area. The sign before 1 suggests which dataset is significantly larger than the other in that particular area. This shapefile can be visually displayed on map in a way that shows where specifically significant differences occur and which type of observation outnumbers the other at these places by using different colors on the map.

While SPPT is able to test to what extent and at what areas police proactivity is similarly distributed as crime rate, it is unable to tell by what magnitude one set of data significantly differs from the other at places where they are actually significantly different. Neither is it able to process additional information attached at places, such as the time resource police spent proactively at places. Therefore, I proceed with the second

question examining the time police spend proactively at places and how that compares to the crime rate there.

In the second part, ordinary least squares (OLS) regression models are performed based on grid-based systems at the mile level, the half mile level, and the quarter mile level between time police spent proactively at places and their crime rate. Note that one of the important assumptions underlying such regression model is that there has to be a linear relationship between the two variables. However, as suggested in the third probability, the relationship between crime and the period of time police spent proactively at places might be curvilinear. To address the issue, a series of statistical methods are employed to test the possible curvilinearity.

CHAPTER FOUR: ANALYSIS AND RESULTS

In 2013, patrol officers in Jacksonville dealt with over 889,000 calls, around 57% of which were initiated by citizens and 43% by police officers. This suggests a generally high level of commitment to the proactive function by officers in the Jacksonville Sheriff's office, which aligns with existing knowledge of this agency's commitment to crime analysis, evidence-based policing, and research and evaluation[1] (Taylor, Koper, and Woods, 2011).

The data also shows a high level of micro concentration for both citizen-initiated calls and police-initiated calls. Over the course of a year, the majority of addresses produced none to a small amount of calls, while a small proportion of addresses produced disproportionately high level of calls. Similar to the 'law of crime concentration' that Sherman et al (1989) discovered and termed by Weisburd and Telep (2014), crime and disorder (and also in this case, proactive calls) is highly concentrated and unevenly distributed across Jacksonville.

Figure 2 (a) and (b) visually show the spatial distribution of the citizen-initiated and police-initiated calls in Jacksonville in 2013. It provides a general picture of where crime or police proactive work occurs and concentrates. As shown in Figure 2 (a), the majority

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[1] Micheal Edwards, the Director of the Department of Patrol and Enforcement for the JSO, and Jamie Roush, the Crime Analysis Unit Manager for the JSO, won the Evidence-Based Policing Award in 2012 for their commitments in using and conducting policing research and their central roles in the implementation of a high quality research program in their affiliated agency. For more information: http://cebcp.org/hall-of-fame/

of calls for crime occurred at the central downtown area of Jacksonville. Considerable

amounts of crime calls were also generated at the south and east parts of the city, and also

some occurred at the north area. The west, northeast, northwest and southeast parts of

Jacksonville, however, are much less crime-ridden as reflected by the call for service data

except for places nearby the arterial roads. Figure 2 (b) shows basically a similar pattern,

suggesting a rough spatial consistency between crime and police proactivity at the very

macro level.

Crime
(a)

Police Proactivity
(b)

Figure 2 Geographic distribution of call for service data

The data also reveals what types of problems patrol officers in Jacksonville are

generally dealing with respectively for citizen-initiated calls and the calls that they

themselves generated. Table 2 shows the categorization and distribution of different types

of calls for crime. As explained in previous chapter, only certain categories are retained

in order to capture offenses that are commonly regarded as crime. Among these

categories, minor offenses account for the majority of crime calls including disorder

(44.45%) and suspicious incidents (26.01%), followed by more serious crime including

property crime (14.53%) and violent offenses (13.21%). Different from expected, drug

and vice issues occurred at the rate of only around 1.79% in Jacksonville in 2013. This is

similar to what is found by Lum (2011), who argued that the unusual low frequency of

drug and vice incidents occurs partly because such incidents could also be recorded as

"disorder" or "suspicion" in calls for service data.

Table 2 Categorization and distribution of crime

Description	N	%
Disorder incidents:	111,900	44.45
Dispute, noise complaint, juvenile complaint, vandalism, mentally ill, animal, illegal parking, shoplifting, drunk, obscene/threat contact, abandoned vehicle, fireworks		
Suspicious incidents:	65,500	26.01
Suspicious person, alarm, prowler		
Property offenses:	36,600	14.53
Theft, burglary, forgery/worthless/fraud, auto theft, con		
Violent, Person, and Weapon crimes:	33,200	13.21
Domestic, assault, discharge firearms, fight, robbery		
Crime of drug and vice:	4,500	1.79
Drug investigation, prostitution.		
Total	251,700	100

With regard to proactive activity, the distribution of activities of officers differs from

calls for service. As shown in Table 3, investigative activities account for the largest

amount of police proactivity with a proportion of around 39%. Investigative activities

could include a variety of activities. For example, if an officer approaches an individual

for information, he or she could record it as an investigation. This could also include

follow-up investigations for crimes that have already occurred. Or, officers might be

examining a suspicious car or person that they notice. Service activity such as "checking

individual or property" or "assisting motorists" is the second largest category with a

proportion of around 36%, followed by traffic related incidents (around 11%). The five

types of problems that categorize crime together account for around 11% of police

proactivity. This is not surprising since police proactive work is by nature different from

reactive one as police are being general and preventive rather than responding to a

specific problem.

In sum, the basic examination of the data provides some background information

about crime and police proactivity in Jacksonville. Overall, police in Jacksonville seem to

invest relatively high levels of resources doing proactive work. These proactive resources

tend to vary across places and concentrate only in certain areas. The important question is

that does the concentration of proactive resources correspond with that of crime calls?

This will be further examined by the SPPT analysis.

Table 3 Categorization and distribution of police proactivity

Description	N	%
Investigation:	109,100	39.49
Investigate, follow-up		
Service:	99,800	36.13
Check individual/property, assist		
motorist, found property		
Traffic-related incidents:	29,100	10.54

Traffic-related, crash, reckless driver, hit & run crash, drunk driver, hit & run		
Suspicious incidents:	14,500	5.26
Suspicious person, alarm, prowler		
Disorder incidents	9,600	3.48
Dispute, noise complaint, juvenile complaint, vandalism, mentally ill, animal, illegal parking, shoplifting, drunk, obscene/threat contact, abandoned vehicle, fireworks		
Administration:	8,500	3.08
Special assignment		
Property offenses	3,300	1.21
Theft, burglary, forgery/worthless/fraud, auto theft, con		
Crimes of drug and vice	1,200	0.42
Drug investigation, prostitution.		
Violent, Person, and Weapon crimes	1,100	0.39
Domestic, assault, discharge firearms, fight, robbery		
Total	276,200	100

Does Police Proactivity Correspond with Where Crime Occurs?

Part one of the analyses examines the geographic similarity between police

proactivity and crime using SPPT analysis. Table 4 shows the first part of the SPPT

output: Indices of Similarity of the spatial patterns between police proactive work and

crime at the census tract level, the block group level, and the street block level.

Generally, the figures are low except at the street block level where the Index of

Similarity increases. Police proactive work and crime are similarly distributed in around

5% of the census tracts or block groups, and in around 44% of the street blocks. Overall,

it suggests a low level of spatial consistency between crime and police proactivity when

they are compared proportionately.

Table 4 Indices of similarities

Unit of Analysis	Sindex
Census Tract	0.0517
Block Group	0.0510
Street Block	0.4411

In addition, Table 4 shows that as the spatial unit of analysis becomes smaller, the Index value grows larger. This is not surprising as Andresen and Malleson (2011) find a similar pattern. They test the stability of spatial patterns for different types of crime over time at different levels of spatial scales using SPPT and find a growing consistency at smaller scales of analysis. They argue that part of the reason for this phenomenon is that the percentage of spatial units that have no crime increases when smaller units of analysis are used. They conclude that "smaller units of analysis will have greater degrees of similarity due to the presence of all the zeros" (p.69). In this case, the similarity index is significantly larger at the street block level because the percentage of street blocks that have no crime and police proactivity is substantially larger than that at the street group level or census tract level. In order to address the issue, Andresen and Malleson (2011) undertake a sensitivity analysis by performing the Spatial Point Pattern Test again with only nonzero spatial units. They find indeed a significantly narrowed difference between different spatial levels regarding their similarity indices, but the pattern that spatial consistency becomes more apparent at smaller units remains[2].

The second part of SPPT output contains shapefiles that can be visualized into maps. As shown in Figure 3 to Figure 5 (a), the black areas suggest places where crime is

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[2] Performing SPPT with only non-zero cases in this study resulted in S indices of 0.04624 at the census tract level, 0.04517 at the block group level, and 0.1498 at the street block level. This is similar to the pattern found in Andresen and Malleson (2011).

significantly and proportionately greater than police proactivity, the grey areas are those at the opposite, and the white areas are places where no significant difference is observed. Overall, the maps present similar patterns at the census tract level and the block group level, yet a varied one at the street block level. Most strikingly, a much larger level of variability is observed at the street block level, as shown in Figure 5 (b), the central area of Jacksonville at that level. In Figure 5 (b), street blocks next to each other might have totally different patterns of resource distribution, some of which have higher citizen calls (black areas), some have more proactive calls (grey areas), and some are more balanced (white areas). This high variability at the street block level suggests that the difference of the amount of police proactive resource relative to the amount of crime occurs at the very micro level.

This is likely to be a reflection of the spatial variability of crime itself at the micro level. Weisburd et al (2004) discovered the street by street variability of crime at the street block level showing that even in the most crime-ridden neighborhoods there is tremendous variance among streets with respect to their crime rates. It is possible to have streets with any level of crime from no crime at all to moderate or high levels of crime nearby a high crime street in Seattle (Weisburd et al, 2004). Thus, a high variability will naturally be observed in this case if police proactivity does not proportionately match the highly varying crime rate at the street level.

It is important to note that even though we expect places with more crime to receive accordingly more police proactive activities, we do not expect such relationship to be rigorously proportional especially at the micro level. In fact, such relationship at the

street block level can hardly be highly proportional in real world. First, it is unrealistic and unnecessary to proactively dispatch patrol officers to micro places across the city based on a single simple numerical calculation of citizen calls. Police can be place-based without meeting this proportionality. Moreover, the number of citizen calls occurred at micro places change over time regardless of how stable crime distribution is. Allocating police proactive resource based on the calculation of even the most recent citizen calls does not necessarily make it proportionately align with the current distribution of crime calls at the street block level. In saying that, the purpose is to raise caution in interpreting the statistical variability observed above. It does not necessarily imply a non-place-based patrolling strategy as real world place-based policing does not have to strictly meet with the statistical proportionality underlying SPPT.
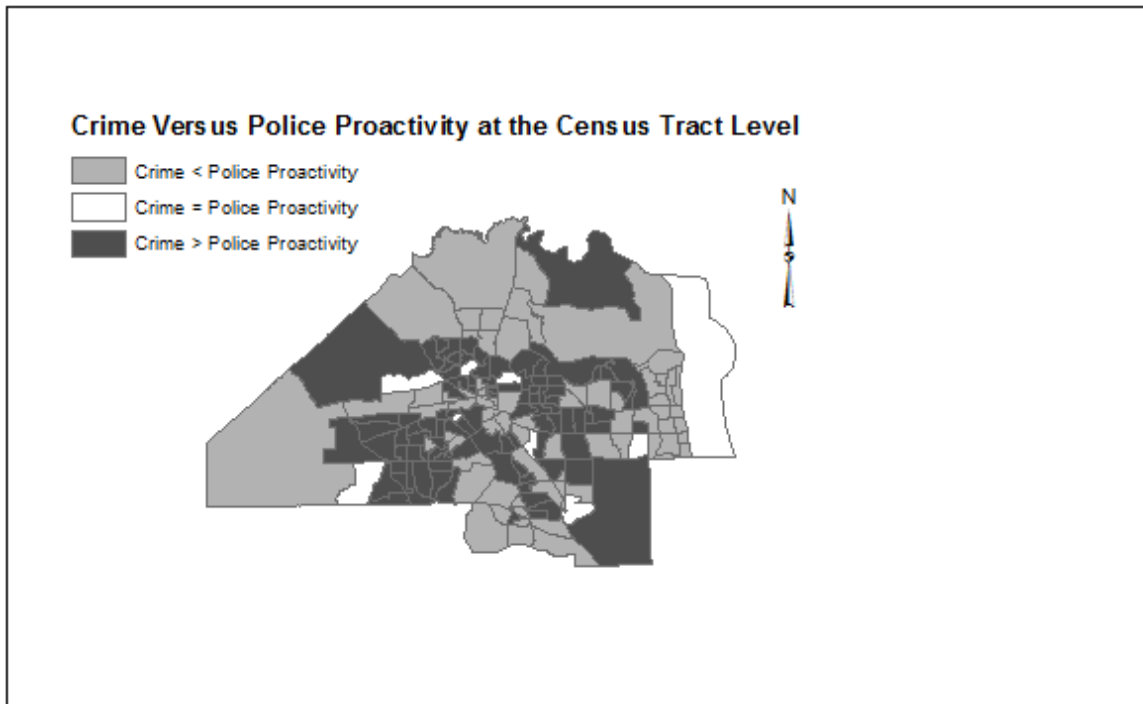
Figure 3 SPPT map at the census tract level

Several other observations can be made from Figure 4 at the block group level, a spatial level that has been validated as meaningful for analyzing crime by prior studies (See Yang, 2010). First of all, white block group is the least frequent among the three (with a number of 29), indicating a low level of similarity between the spatial patterns of police proactive works and crime when they are compared proportionately at the block group level. This is similar to the results suggested by the Similarity indices Table, as presented above. Second of all, the number of block groups is 171 for the grey type and 290 for the black type, suggesting that in most block groups, crime rate is proportionately higher than police proactive activities there.
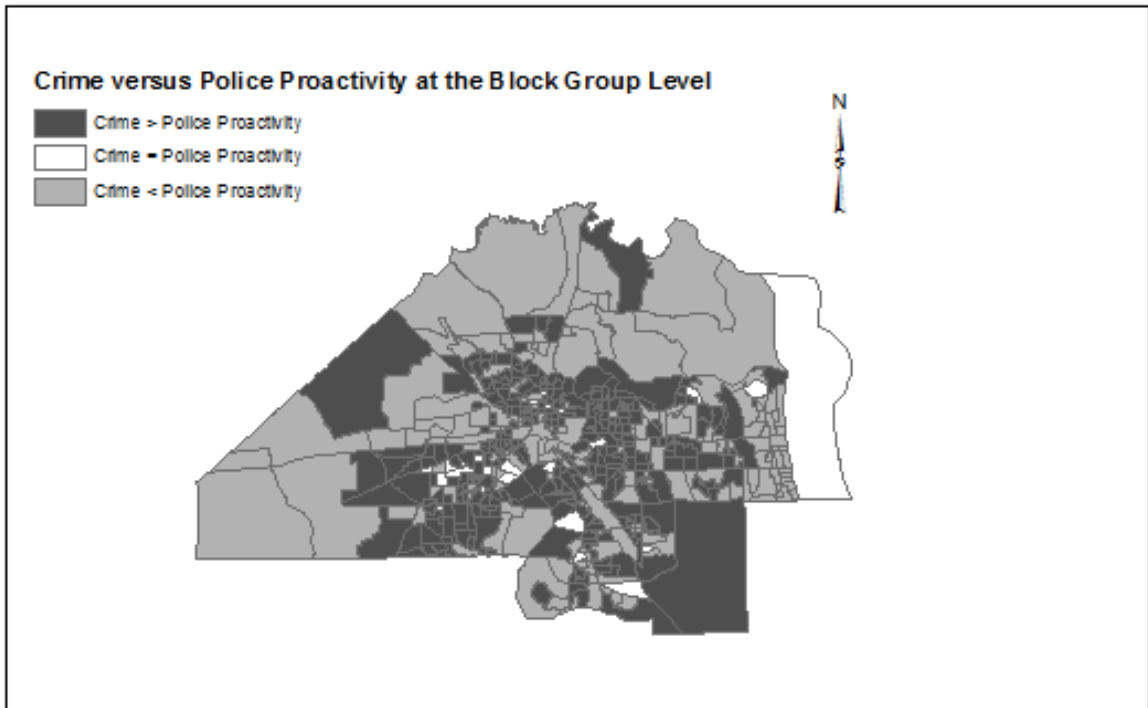
Figure 4 SPPT map at the block group level

Again, these exploratory spatial findings do not imply that police in Jacksonville are not proactively allocating their resources to high-crime places. In fact, several further observations from the map indicate a more complex spatial relationship between crime and police proactivity in Jacksonville. First, in around 35% of block groups in Jacksonville, police proactivity proportionately outnumbers crime rate, making a considerable part of Jacksonville grey. This in and of itself suggests a stronger commitment to proactive activity compared to other jurisdictions[3].

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[3] This is based on the knowledge from the research team in CEBCP about the working mechanisms in other police agencies.
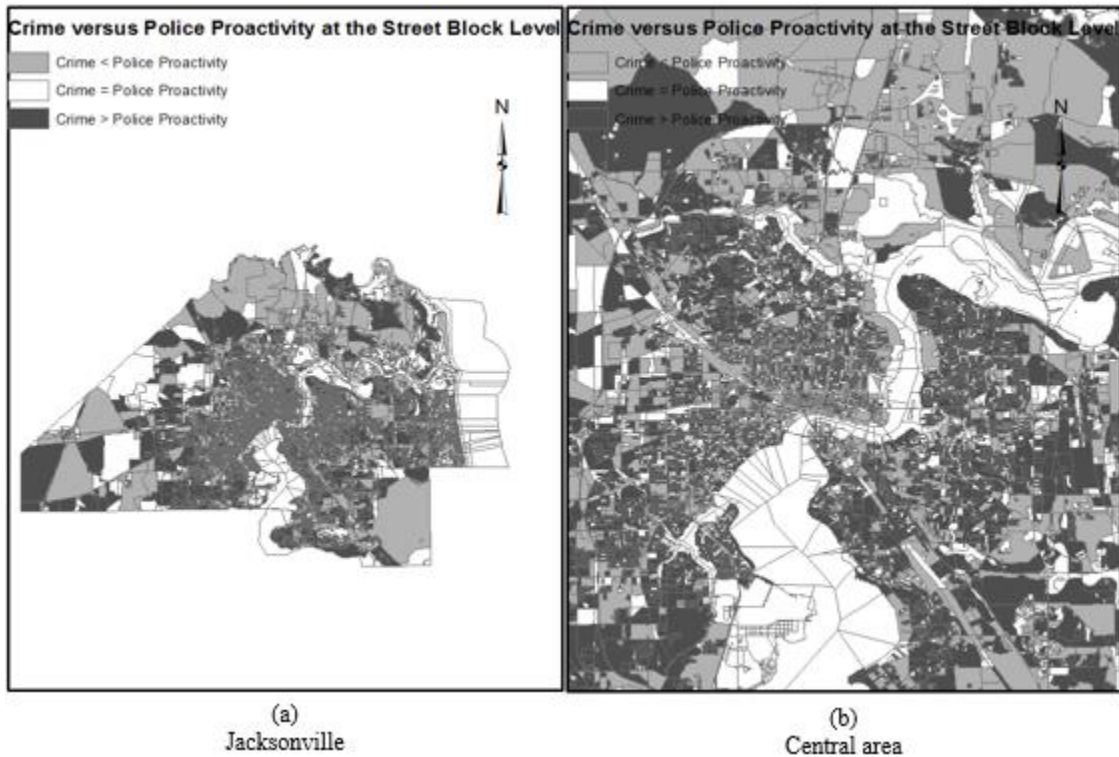
(a)
Jacksonville

(b)
Central area

Figure 5 SPPT map at the street block level

Second, even in places that share the same color-coded classification, the dynamic between police proactivity and crime is not necessarily the same. In fact, there seems to be at least two possible explanations in areas where police proactivity is proportionately greater than crime rate. First, police conducted significantly higher proportion of proactive work in the most central part of the city in Figure 4 where, as shown in Figure 2, crime is most concentrated. Police seem to know that this area is most crime-ridden and they proactively allocated significant amount of resources in the central area to tackle the crime problems there.

Meanwhile, police also conducted greater levels of proactivity at some of the peripheral areas that are relatively free of crime. One possible explanation is that police

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might conducted considerable traffic-related proactive works in these outer areas since those are where some of the arteries are. However, further exploration of police proactivity in some of these outer areas suggests that rather than traffic related work, service work such as "checking individual or property" accounted for the majority of police proactive work in the outer areas where proactivity is proportionately greater than crime. This phenomenon raises interesting speculation about police work in Jacksonville and possibly provides certain supports toward the first probability stated at the outset. Probability one stated that police proactive resource focuses primarily at places with less or none crime. It presumes an equity that is based on efforts (probability one) rather than needs (probability two). Figure 4 suggests that by allocating higher amount of proactive resources in places with both highest and lowest crime rate, police in Jacksonville seem to be having a balanced working philosophy, combining equity based on needs as well as efforts.

Overall, results of the SPPT analysis show that police seem to know where crime occurs, and that they are trying to allocate their proactive resource based on the spatial distribution of crime, even though such efforts did not produce a very high level of spatial similarity between crime and police proactivity when they are compared proportionately. The reason of the low similarity indices SPPT returned might be related to the statistical rationale underlying SPPT. As stated earlier, SPPT compares the proportion of crime and proactive work within each area. It returns significant different results for an area if the proportions for two sets of data differ significantly in that area. As a result, SPPT will return a low Similarity Index value overall if patrol officers in Jacksonville did not

allocate proactive resources *proportionately* based on crime distribution, even if they did allocate more resources proactively at places with more crime. This non-proportionality could lead to a low Similarity Index and, at the same time, might indicate a possible non-linear relationship between crime and police proactivity. This will be further examined below in the second part of the analysis.

Do Police Spend More Time at Places with Higher Levels of Crime?
The second part of the analysis employed OLS regression models, with the purpose to investigate specifically how much time police allocate proactively at places and how it compares to the crime rate at those places. In other words, if places have more crime, do police not only conduct proactive activity (as discussed above), but also spend more time conducting proactive activity at those places? To examine this question, regression models are employed based on three grid systems, in which the lengths of the cells are defined respectively as one mile, a half mile, and a quarter mile, so as to investigate the relationship between crime and the amount of proactive time police allocate at different levels of places.

Before employing the regression approach, it is important to first examine one of the important assumptions underlying OLS regression model-- linearity. OLS regression model assumes that the relationship under examination is linear. However, as suggested by the third probable answer to the research question, the relationship between proactive time police allocate at places and crime rate might be curvilinear rather than linear. Specifically, at places with very high crime rate, patrol officers might have to spend most of their shifts responding to citizen calls for service and would thus have less time for

conducting proactive work. As a result, as crime increases at places, the amount of proactive time or proactive records there might increase first and then decrease after a certain threshold of crime. This curvilinearity, if exist, will make the regression model less reliable.

Several efforts are made in order to test the possible curvilinearity. First of all, scatter plots are generated between crime and proactive time and proactive records at each of the three spatial levels. Figure 6 (a) and (b) show the scatter plots at the quarter mile level, where the most scattered pattern is observed. An eyeballing of these two figures suggests a general linear relationship between crime and police proactivity or proactive time police spend at places. On the other hand, however, several outliers are also observed mostly on the upper left part of the graph where there are low to moderate levels of crime but disproportionately high level of proactivity, which might twist the linearity of the scatter plots.

The occurrence of these outliers could be due to several explanations. First, police might have imprecisely identified these areas as hot spots. Ratcliffe and McCullagh (2001) found that patrol officers tend not to accurately identify where hot spots are. They might have picked places with moderate levels of crime as hot areas since these places do have more crime than most others, but in fact they are not the hottest areas. Another possibility speaks to the possible causal effect between crime and proactive work of patrol officers. In other words, the amount of crime at places is significantly less than the amount of proactivity because intensive proactive work at places has a causal impact on crime that it reduced the amount of crime there. Whichever case might be, it is clear that

the scatter plot itself does not allow any firm statement regarding the possible curvilinear relationship between crime and police proactive work, especially considering the outliers observed in the relationship.

In order to test the possible curvilinearity more rigorously, a squared term of crime is incorporated into the regression model, the coefficient of which will allow us making direct decision regarding the curvilinearity of the relationship. Different from what is firstly suggested in the scatter plots, significant coefficient values were observed for the squared term at two of the three spatial levels, indicating the existence of curvilinearity. This might suggest a real curvilinear relationship between crime and police proactivity, but as mentioned earlier, it is also likely to be caused by the several extreme outliers observed in Figure 6 (a) and (b) alone.
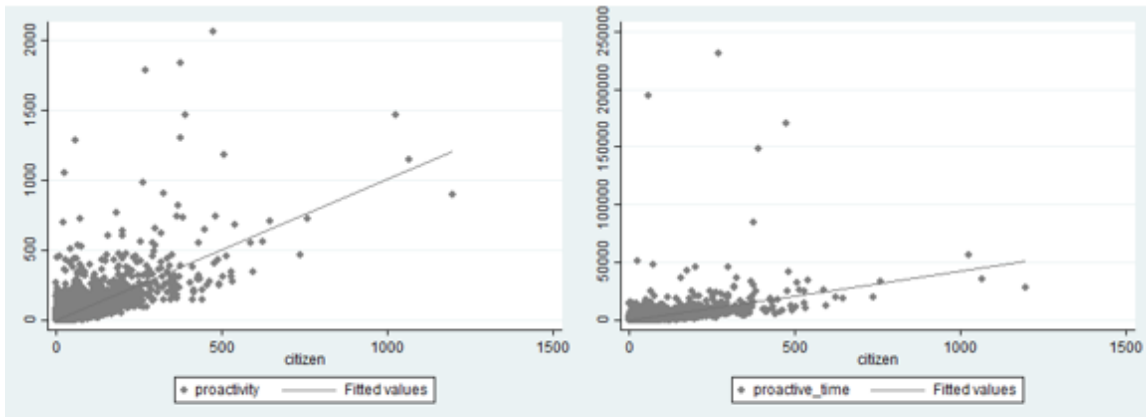

N of Proactivity
(a)

Proactive Time
(b)

Figure 6 Two way graph between crime and proactivity/ proactive time at the quarter mile level

In order to address the issue of outliers and to understand the real relationship between crime and police proactive work, I conducted several further analytic steps. First, the top ten outliers were identified from the data and manually checked to understand the nature of these addresses and to make sure that they are not "crime magnets" such as police stations or hospitals. Results show that the top ten addresses direct to a variety of places including schools, shopping centers, public parks, and even residential areas. They are outliers because patrol officers initiated a large number of proactive activities in those places in 2013, resulting in a large amount of proactive time police allocated there. Second, I deleted all the outliers from the sample and then run the regression model with the squared term. Surprisingly, curvilinearity is now observed in the model at all three spatial levels, suggesting a real curvilinear relationship between crime and police proactivity. This may suggest that places with high levels of crime may require more police response to calls for service, and less time for proactive activity.

Figure 7 (a) and (b) show the scatter plots between crime and police proactivity and proactive time police allocate at places after deleting outliers from the sample. The solid line suggests the "fitted values" or the values predicted by the regression model, and the dash line ("lowess") shows the real relationship between variables of interest. As shown on the graph, different from the increasing-decreasing curvilinear relationship predicted by the third probability, there is in fact a slightly upward increasing curvilinear relationship between crime and proactive work of patrol officers. More specifically, as crime goes up, the amount of proactive activities or proactive time police allocate at places grows larger with an increasing speed, suggesting that strikingly, patrol officers in

Jacksonville are trying to allocate disproportionately more proactive resource at places with high levels of crime. In particular, the relationship takes off when the amount of crime is larger than roughly 350 per year at the quarter mile level. This answers the question in the first part of the analysis of why SPPT returned such low indices of similarity even though patrol officers seem to be doing a place-based proactive work. They follow an upward curvilinear logic rather than a linear one in allocating their proactive resource based on the spatial distribution of crime so that places with more crime will receive the most concentrated proactive resource.
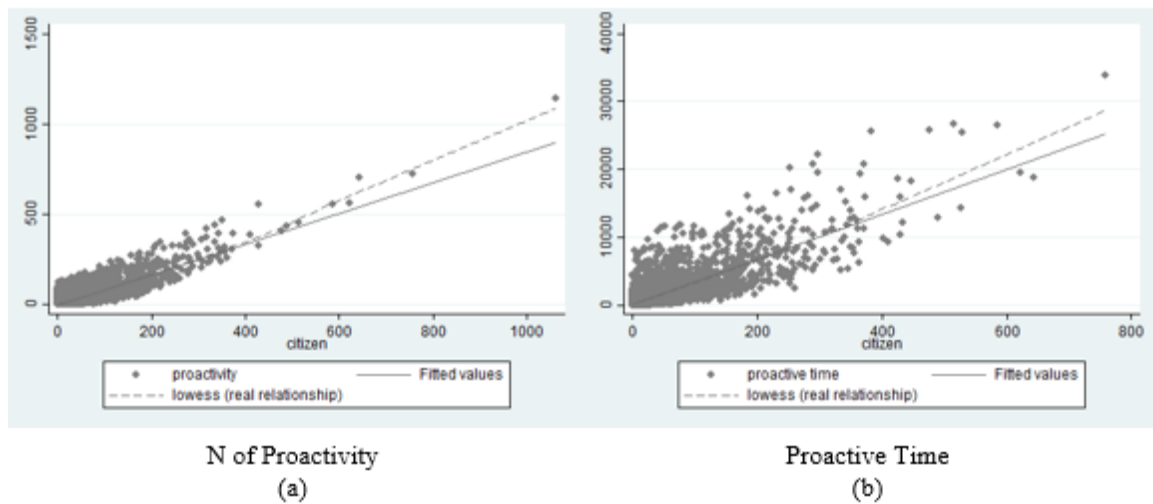
Figure 7 Two way graph at the quarter mile level after deleting outliers

Considering the small scale of the curvilinearity as shown by the microscopic coefficient value of the squared term (provided in the appendix) and the fact that the vast majority of places have only none to small levels of crime, the OLS regression models are still able to provide useful information despite the curvilinearity observed. Table 5

and Table 6 shows the results of the regression analysis with and without the squared term. The coefficient values are generally lower when a squared term is included. This is not surprising since technically coefficients resulting from the inclusion of the squared term in the model are the slopes of the curve at the very outset. As crime goes up, the slopes of the curve will gradually approach and might even exceed those in Table 5 where no squared term is included. Overall, the coefficient values remain relatively high and stable across different levels of spatial scale, indicating that patrol officers in Jacksonville are not only proactive, but also allocate their time accordingly even at small geographic scale. For example, at the quarter mile level, each crime call at places is linked to around one proactive call or around 43 more minutes of proactive time police spend at that place, suggesting a high orientation toward proactive work at the micro level in Jacksonville. R square becomes smaller as the spatial unit goes down, which is natural as there are more cases to explain at smaller spatial scales. Moreover, considering also the curvilinearity observed, the figure will grow even slightly higher though not much as crime at places goes up, making the patrol strategy in Jacksonville a highly proactive, place-based, and geographically micro-scaled one.

One of the concern about polynomial models speaks to the potential large error resulting from the high covariance or dependency between parameters. In order to minimize the math error, I centered the model by subtracting mean from the independent variable and performed the regression analyses again (a technique used by Bradley and Srivastava, 1979). New regression results are provided in the appendix. Overall, little change is observed. Results of the centered model remained unchanged for p value and R

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square while slightly increased for coefficient values. Each crime is now related to even slightly higher proactivity or proactive time police allocated at places in the centered model, making it safe and reliable to conclude that JSO is highly proactive and place-based in allocating their patrol resources.

Table 5 Regression table between crime and proactivity/ proactive time

Grid Length	Coef. (Regress proactive N on crime)	P/R^2	Coef. (Regress proactive time on crime)	P/R^2
1 mile	0.982	.000/.752	42.942	.000/.576
Half mile	1.018	.000/.609	45.847	.000/.379
Quarter mile	1.009	.000/.508	42.883	.000/.244

Table 6 Regression table with squared term of crime

Grid Length	Coef. (Regress proactive N on crime)	P/R^2	Coef. (Regress proactive time on crime)	P/R^2
1 mile	0.808	.000/.758	36.160	.000/.580
Half mile	0.836	.000/.616	35.027	.000/.386
Quarter mile	0.979	.000/.509	43.889	.000/.244

CHAPTER FIVE: DISCUSSION AND CONCLUSION

Ever since Sherman and Weisburd (1990) in their Minneapolis experiment on hot spots patrol found a positive impact of increased police presence on crime and disorder at micro spatial scale, studies have been establishing a solid evidence base for hot spot policing in different settings. These studies have made a compelling case that police can be effective by allocating their resources in proactive and place-based ways (for review of this research, see Lum, Koper, and Telep, 2011; Sherman and Eck, 2002; Weisburd and Eck, 2004). Efforts have then been made to not only understand what works, but also whether practitioners are employing what works and how research evidence can be better translated into practice (Lum, 2009; Lum and Koper, 2012; Sherman et al., 2014; Weisburd et al., forthcoming). Despite the many challenges scholars have proposed for research to influence practices, Jacksonville provided a striking illustration that practitioners are following scientific evidence in allocating their resources and deploying patrol officers.

Specifically, results suggest that patrol officers in Jacksonville are being largely proactive and place-based in allocating their resources. They spent a large proportion of their resource (almost half) conducting proactive work, and concentrated such proactive resource primarily at the most crime-ridden areas. More specifically, they generated around one extra proactive activity for each citizen initiated call for service, and spent

around 40 additional minutes in places that received crime calls. Most importantly, such figures holds stable at the very micro spatial scale and they become even slightly higher at places with high level of crime (higher than 350 per year at the quarter mile level), suggesting the commitment of police in Jacksonville toward hot spot approach. There are, of course, outliers where the amount of proactivity or proactive time being allocated at places differs significantly and largely from the amount of crime there. But the above trend stays true for the vast majority of places, making the patrolling strategy in Jacksonville a highly proactive and place-based one.

How Jacksonville Sheriff's Office compares with other police agencies is beyond the scope of this study. However, this analysis shows one way of determining the performance of agency with regard to their level of proactive police behavior. Given the push towards more preventive, proactive, and place-based approaches, finding ways to determine how agencies are performing in this regard is key.

The study also empirically revealed the complexities that exist in the relationship between police proactive work and crime at places. Specifically, several mechanisms might be influencing their relationship at the same time. First of all, if police are being proactive and place-based, a positive spatial correlation will be expected between the spatial distribution of police proactive work and crime (Probability two). In this study, an upward curvilinear form of the positive correlation is observed, which supported the second probability proposed at the outset of the study. While generally places with more crime were allocated with more police resource proactively, places with high enough crime rate received disproportionately high amount of proactive resources. This accords

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with the hot spot literature, which requires police to concentrate their resources at crime hot spots to be most effective and efficient.

Second, Nagin, Solow, and Lum (2015) pointed out the importance of the potential causal impact of police proactive work on crime and also the nuances existed in the relationship between these two variables. This thesis provides empirical support toward such complexities. By allocating more proactive police resource at places with more crime, over time we should, according to what is known from previous hot spot research, notice a negative relationship, or a causal effect, between police proactivity and crime. In other words, if patrol officers are being effective by conducting place-based proactive work, we would observe a reduced crime rate at places with high level of proactive work. This further implies a potential looping process between crime and police proactive work. High police proactivity that resulted from high crime rate at places could lead to reduced crime problems there and further lower proactive attention from police in those places. This raises caution in defining places with unmatched crime and police proactivity using stationary data. These places, with high proactivity over crime, could either be outliers that police inaccurately identified as hot areas, or areas where proactive work is being effective. Different explanations have distinct, if not contrasting, meanings for decision makers in deciding officer performance. The current study does not allow us answering the question as it employed cross-sectional data and looked only at correlation. To determine this and to determine more broadly the ongoing dynamic between crime and police proactive work, longitudinal data is needed so as to look at the change of crime and police proactive resource at places over time.

A relevant complexity that raises caution in understanding police proactive work and its relationship to crime speaks to the definition of police proactivity. Even though police proactivity is measured as all calls initiated by police officers in this thesis, there can be different types of proactive works that resulted from different processes. When the police identify places that are long risky based on their analyses of the long-standing historical and contextual problems of places and then decide to assign more proactive resources to tackle problems there, they are being rigorously preventive with a long-term perspective. However, police could also be assigning more proactive resources to places as a response to the temporal crime spikes there, in which case they are still being more reactive rather than proactive with a short-term strategy. Even though the first type of proactivity is preferred as it is preventing the crime spikes from occurring, both processes could be happening in Jacksonville. This, again, requires longitudinal data and further attention in future research.

Next, even though not clearly observed in the study, it is still conceivable for probability three to have occurred. Probability three suggests that responding to citizen calls in high crime areas could possibly leave less resource for patrol officers to conduct proactive work. When that happens, places with more crime than proactive work might signal a lack of available resource in those areas. Further investigations are necessary in understanding the resource utilization of patrol officers in places with high amount of crime and relatively low amount of proactivity, as commanders will need to make decisions to either deploy extra resources to those areas or to direct existing officers to conduct more proactive work.

Finally, the study possibly provided certain supports for the first probability. Probability one stated that the police distribute resources not only based on where crime concentrates, and thus they might proactively allocate their resource in places that have fewer crime problems. Results suggest that police, while still prioritizing places that are most crime-ridden and thus have the greatest needs, also provided considerable amount of proactive efforts in places with less crime. It possibly suggests the concern of the police in Jacksonville about not only tackling crime hot areas, but also ensuring the general wellbeing and equity of resource distribution across the city. In future studies, it is necessary to incorporate not only quantitative but also qualitative information and understand the perspective from police practitioners.

Several other future efforts are possible. First, it is important to understand the causality between proactive work of patrol officers and crime at places and also the related cost efficiency. For example, the average time patrol officers spent on a citizen call for service in Jacksonville is around 40 minutes. If a patrol officer spends 40 minutes proactively at a place, is he or she able to prevent at least one crime call so that he or she will save another 40 minutes that would have been used in responding to that call? Such question is critical in that it points out the possibility of reducing crime simply through adjusting the existing distribution of police resources. If the answer is positive, police will reduce crime with no extra resource. Koper curve (1995) suggested that the optimal time patrol officer stay at a place to maximize residual deterrence is around 15 minutes. Based on that, 40 minutes of proactive work, if employed scientifically, should be able to prevent far more than just one crime call from happening and is thus able to save more

resources for other purposes in the long run. Experimental designs or longitudinal data are needed for future efforts to understand such questions.

It is also important to further understand the specific activities of patrol officers. This study examined generally how many proactive work police conduct, what types of problem they are usually tackling, and where they concentrate their proactive resources. However, a number of questions remain and can hardly be answered with existing call for service data. For example, how do patrol officers spend their shift? How much available time do they have for conducting proactive work and how much time during their shift do they choose to do something proactive? What types of information are useful and needed to help them be more place-based, proactive, or effective? Scholars cannot understand these questions without incorporating the perspective of patrol officers into research. Efforts are also needed in figuring out how research on proactive strategies can be better translated into patrol practices and also the technical issues in delivering evidence-based practice (Lum et al., 2012). For example, what could be done to better harness the available time officers have and turn it into effective proactive resources? Weisburd et al (forthcoming) test the effect of automatic vehicle locator on harnessing unallocated time and found positive results at micro spatial units. Perhaps other types of technologies might facilitate proactivity as well.

The findings also highlight the importance of practitioners taking initiatives for balancing reaction to crime with proactive approaches. As suggested by Weisburd (2008), a place-based approach requires police organizations to make fundamental and systematic adjustments. Most basically, field data needs to be collected in such a

comprehensive way that reflects not only the features of individuals but also characteristics of the context. Weisburd (2008) also suggests other changes including shifting the focus or promotion criteria from making arrest to reducing the opportunities at places, concentrating their focuses on micro spatial scale to prevent and reduce crime at hot spots, and expanding their toolbox beyond merely traditional law enforcement, all of which cannot be achieved without the efforts and dedication from the practitioners. Lum (2009) and Lum et al. (2012) also discuss the need for adjusting core aspects of policing to accommodate innovations reflected in research. Further researches are needed in understanding to what extent these elements have been institutionalized into police agencies and what could be done to facilitate that process.

Some limitations of the study should be noted. Results in the study might not be generalizable to other police departments, especially those focusing primarily on traditional ways of policing. As aforementioned, JSO has a unique organization environment because of its high commitment toward research and its cosmopolitaness. Specifically, there is a commander-level emphasis in Jacksonville emphasizing tackling crime using data-driven approaches and also a managerial process (Compstat process) that makes sure the implementation of evidence-based policing[4] (Taylor et al, 2011). As such, JSO is not considered a typical police department and might not be able to represent most police organizations. It is certainly conceivable to expect a lower proportion of proactive work and less emphasis on the micro concentration of crime in police departments that are relatively more conservative or in places that are much less bothered

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[4] This is also based on the knowledge from the professors in CEBCP who had intensive collaborative works with JSO.

by crime. However, the approached used in this study is generalizable; using administrative data to understand the proactivity-reactive mix of activities of officers can be a useful way to assess this important performance measure of police agencies.

The mechanisms that govern the relationship between crime and police proactivity are complicated. This study does not capture all the proactive work of patrol officers and provides only observational information at a single point. Further, this analysis examined primarily correlations between variables of interests and cannot clearly identify detailed causal mechanisms at different places. However, this study does provide preliminary insights into ways that agencies can measure the extent they are proactive using existing data. Advanced and detailed information and studies are needed for future efforts to provide a more comprehensive examination of police empirical work and their proactive allocation of resources.

Conclusion

This research was conducted to explore what patrol officers are doing on street and how they proactively allocate their resources in relation to the geographic distribution of crime. Results suggest that patrol officers in Jacksonville are, to a large extent, proactive, place-based, and micro-scaled in allocating their resources. They provided a striking example of practitioners closely following research evidence. In addition, the study also provided methods of evaluating the performance of police agencies. Considering Jacksonville Sheriff's Office as a single and non-typical police agency, it is important for future studies to replicate such analyses to understand police activity in

other agencies. Additional research is also needed to employ more detailed and

qualitative data and incorporate the perspective from practitioners in understanding the

empirical works of police officers.

Table 7 Regression model with squared term of crime at the mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2
Crime	.808	.000	.758	36.160	.000	.580
Squared crime	.000	.000		.004	.003	

Table 2 Regression model with squared term of crime at the half mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2
Crime	.836	.000	.616	35.027	.000	.386
Squared crime	.000	.000		.016	.000	

Table 3 Regression model with squared term of crime at the quarter mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2
Crime	.979	.000	.509	43.889	.000	.244
Squared crime	.000	.062		-0.002	.405	

Table 4 Centered regression model at the mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2
Crime	.862	.000	.758	38.280	.000	.580
Squared crime	.000	.000		.004	.003	

Table 5 Centered regression model at the half mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2

	Coef.	P			P	
Crime	.885	.000	.616	37.946	.000	.386
Squared crime	.000	.000		.016	.000	

Table 6 Centered regression model at the quarter mile level

	Coef. (proactivity)	P	R^2	Coef. (proactive time)	P	R^2
Crime	.984	.000	.509	43.732	.000	.244
Squared crime	.000	.062		-0.002	.405	

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BIOGRAPHY

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