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Do Visits or Time Spent in Hot Spots Patrol Matter Most?

A Randomised Control Trial in the West Midlands Police

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Abstract

We are now in an era of policing where public expectation is greater than ever and it is only right that we are held responsible for our commitment to service our communities and protect them from harm (Foulkes, 2014). Set this against the fact that UK Policing and, in particular the West Midlands Police, are facing austerity unlike that seen by any previous generation of policing and as a result have an ever smaller workforce it is paramount that we prioritise demand reduction and tightly focus resources in an evidence based manner.

This experiment is set against the backdrop of targeted place based demand reduction implementation across the West Midlands Police force area in an unprecedented time of austerity and uncertainty for those charged with delivering patrol; Neighbourhood Police Constables and Police Community Support Officers, both of which are an endangered species.

This paper reports on a practitioner led randomised control trial that took place in the West Midlands Police during the summer of 2015. The main objective of this study were to assess if shorter and more frequent patrols (9 units of 5 minute patrols per day) in hot spots reduced crime and anti-social behaviour more than less frequent longer patrols (3 units of 15 minute patrols per day). The second objective of this study was to capture officers patrol outputs in order to examine which activities, if any, are high or low in frequency; do these outputs matter as much as providing visible capable guardianship?

An experiment was designed in which 7 hot spots were randomly allocated to one or other patrol mode for a period of 150 days between June and November 2015. Patrol visits were tracked using patrolling officers' personal issue G.P.S (global

positioning system) 'Airwave' radios where patrol information was fed back and officers help to account for the number of patrols conducted. Although this research took place over 150 days the results presented are based on 100 days of patrol as a result of a breakdown in 'geo-fencing' software during the last 50 days.

Fewer units of longer duration are associated with greater crime falls, indicating that they are more effective than more frequent shorter patrols. The findings from this experiment confirm Koper's (1995) finding that longer units of 10-15 minutes duration are more effective.

Additionally activity analysis of police constable and police community support officers overwhelmingly indicates that the highest frequency outputs, accounting for nearly 90% of all activity during 15 minute patrol days, do not require police powers (i.e. Community engagement and visits to high demand crime and ASB micro-locations within hot spots).

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For my Grandparents; Rose, Bert, Val & Don

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Introduction

Purpose and Structure of This Research

This paper reports on an experiment that comparatively tested 15 minute 'Koper Patrols' versus 5 minute 'Pop-Up Patrols' over a period of 150 continuous days beginning in June 2015 where each day was randomly allocated to 15 minute or 5 minute patrols. Koper patrols were conducted 3 times during the hours of 2pm and 11pm on their assigned days and Pop-Up patrols were conducted 9 times during the same time period on their assigned days providing an intended patrol dosage of 45 minutes per day. Patrols were conducted across 7 treatment hot spots located in Birmingham where officer visits were tracked via their personal issue GPS (Global Positioning System) 'Airwave' radios.

Officers conducting patrols were also asked to complete basic activity analysis of their outputs whilst patrolling hot spots. This begins to answer the question of exactly what is it that the police do in hotspots, an important question when considering what type of formal capable guardianship is required, i.e. a sworn police officer with powers of arrest and stop and search or an unsworn police community support officer (PCSO) with limited powers. The future staffing levels of local policing across England and Wales is uncertain, therefore, a baseline of patrol activity ought to be researched to better inform policy makers what type of patrol, police officer or capable guardian (i.e. Police Community Support Officer) is right to conduct hot spot policing.

There is a growing body of evidence surrounding the place based phenomenon of hot spots policing; Braga, et al. (2012), in their Campbell

collaboration review of suitable quasi or experimental studies, found that hot spots policing is an effective tactic in reducing crime and disorder. Of the 25 studies included in the review there is one study in particular that has, in more recent years been responsible for spawning a new batch of hot spot randomised control trials; The Minneapolis Hot Spots Program (Sherman & Weisburd, 1995). Without the Minneapolis Hot Spots Program there would have been no other available study (taking into account those included in the 2012 Campbell Collaboration Review of Hot Spots Policing) for Koper to analyse the effect of patrol time and provide a recommendation that 15 minutes could be the optimal time for officers to patrol a hot grid. Surprisingly the next time that Koper's 1995 finding would be tested was six years later when Telep, Mitchell and Weisburd (2012) rigorously tested 12-16 minute patrols during a randomised control trial in Sacramento, California.

The growing body of research into hot spots policing and its overall success in reducing crime and disorder has, in many papers been attributed to deterrence theory (Sherman & Weisburd, 1995; Nagin, 2013; Sherman et al., 2014). Put simply deterrence is a combination of certainty of apprehension, severity of punishment and celerity (swiftness) in being brought to justice. Beccaria (1963) and Bentham (1948) long ago theorised that to deter crime, the cost had to outweigh the benefits, the risk of apprehension had to be certain and the severity of punishment had to be great and swiftly imposed (Ratcliffe, et al., 2013). However, increasingly severe punishments over time have contributed comparatively less to the aggregate deterrent effect of the criminal justice system (Durlauf & Nagin, 2011).

In the context of increasing patrols at hot spots of crime and disorder there is a great deal of empirical support and a solid evidence base (Braga, 2007; Weisburd & Braga, 2006) for deterrence increasing the certainty of detection (Durlauf & Nagin,

2011), some of this empirical research and its results are described in this review of hot spots literature.

The purpose of this research was to add to the body of evidence relating to hot spot patrol and to test the twenty year old finding from Dr Christopher Koper (1995) that police can maximise the prevention of crime and disorder by patrolling a hot spot for between 10 and 15 minutes. This finding is commonly known as the 'Koper Curve' which maximises residual deterrence allowing leaders who direct patrol to reduce the total time officers spend patrolling hot spots. It is widely accepted that, put crudely, placing cops on the dots reduces demand at hot spot locations of crime. A Campbell Collaboration systematic review (Braga et al., 2012) backs up an earlier review by Weisburd & Eck (2004) that hot pots policing is effective in reducing crime and disorder, although it is worth stating that not every hot spots study has yielded statistically significant results, the majority report noteworthy reductions in demand.

This experimental research will see the first time that the 'Koper Curve' has been tested against another directed amount of patrol time, in this case shorter 'Pop-Up' visits to each hot spot that are at least half that of the recommended 10-15 minute threshold. The paradigm that 15 minutes of patrol time in a hot spot is optimal has recently been challenged in a forthcoming publication; The Symbolic Quantification of Power; A Randomised Control Trial (Ariel, 2015) where PCSO's were used to provide 15 minute patrols three times each day in each treatment hotspot. Outcome measures here mirrored those included in the 2012 Braga et al. review of hot spots showing significant demand reduction benefits across a 12 month period. However, this study showed that deterrence may have been caused by additional patrol frequency rather than additional patrol duration.

The amount of police patrol presence in any location can be referred to as ‘dosage.’ The key papers in this area are those of Koper (1995) and Telep and Weisburd (2012). Koper (1995) conducted further analysis of results from the Minneapolis hot spots patrol study conducted by Sherman et al. (1989). Koper found a strong relationship between the length of each police patrol, which averaged 14 minutes and the amount of time the hotspot was free of crime after the police left the scene.

The ‘Koper curve’ in the Minneapolis data suggests that the optimum length of a police patrol visit or presence in a crime hot spot is about 15 minutes. Police presence beyond that period of time produced diminishing returns in terms of length of time until the next crime or incident was reported. In simple terms the theory suggests that there is no additional benefit in terms of crime and disorder prevention if police stay fixed or present in a particular hotspot location for long durations, and remaining in the hotspot for greater than 15 minutes produces diminishing returns. However Koper’s theory is based on observations of Police patrols up to 1 hour maximum with most dosages being only around 30 minutes in duration. It is not known whether much longer hotspot patrol dosages which form the basis of this Phase I test will show similar results concerning the effectiveness of 15 minute patrols compared with much greater patrol dosages.

This paper will report on 7 treatment hot spots that were patrolled using 3 x 15 minute days and 9 x 5 minute patrol days, the intention was to treat for 150 days where 75 days would be randomly assigned to each patrol type. Although this was the case a failure in tracking software resulted in 100 days of patrol being analysed; 43 of these had been randomly assigned to 5 minute days and 57 to 15 minute days.

In addition to raw Street Crime counts and ASB calls for service, crime will be converted into a measure of Crime Harm (Cambridge Crime Harm Index) (Sherman, Neyroud & Neyroud, 2014) and measured post 100 days prior to treatment and post 100 days of treatment.

Street Crimes and ASB calls for service will also have additional analysis where data from the same 100 day periods in both 2013, 2014 and 100 days pre-treatment will be discussed. This reported data will also be compared to 7 control hot spots that were pair matched based on total demand over the past 24 month period. These control hot spots were policed by teams that were not being tracked using G.P.S nor were they held to account for their self-reported patrols and performance of hotspots.

The two main questions this research paper sets out to answer are;

1) What matter most in hot spots policing; time spent patrolling or frequency of visits?

2) Do our patrol outputs matter as much as being visible, what activity do Police and Police Community Support Officers conduct when patrolling a hot spot?

Literature Review

Introduction

This literature review will explain and define related theories of deterrence, rational choice and routine activity and focus a lens on those studies which employed the 'Koper Curve' as the primary intervention in tackling crime and disorder at hot spots. Rather than laying these out study by study this review will take a topical approach in addressing the following elements of hot spot policing; dosage, size of hot spots, diffusion and displacement, tracking of patrol dosage and the measurement of crime severity.

Hot Spot Policing & Patrol Dosage

The 1995 Minneapolis experiment (Sherman & Weisburd, 1995) saw police double police patrol in treatment hot spots in comparison with controls with a reported statistically significant reduction in crime and disorder of up to 13%. This was the first hot spots experiment to record, analyse and report in detail time spent by officers actually patrolling a hot spot, other experiments or quasi-experiments such as the Minneapolis RECAP (Sherman, Buerger & Gartin, 1989) and others (see Braga, 2012) used problem oriented policing (POP) tactics such as 'Crackdowns' or 'Enforcement Tactics' as the lever to reduce crime and disorder rather than directed patrols.

There needs to be a clear distinction between the definition of problem oriented policing and hot spot policing, essentially they are linked by the 'law of concentration of crime in place' (Weisburd, Telep & Braga, 2010) but are two quite

different approaches. Problem oriented policing as described by Braga, et al. (2012) suggests crackdowns on certain types of offences, increased enforcement of drug laws and execution of warrants are the main drivers of crime and disorder being clearly targeted. Whereas Hot Spot policing, which has evolved from early experiments using researchers to record the amount of time officers patrol, could be defined as the targeted concentration of officers in time and space where patrols are random and time bounded. Hot spot policing as defined in this way then becomes a tactic for those setting strategy in planning problem oriented policing approaches; crackdowns and directed patrol running side by side could be a very effective tool in cooling down hot spots of crime.

Hot spot policing as a definition is intrinsically linked to what a hot spot is; a hot spot is an area small enough so that when one patrol car or uniformed constable is present, people may see visible police presence from any point in that hot spot (Sherman, 2015 (MST targeting places ref). This relates to what a hot spot is and is not, in particular the range of hot spot sizes described in the literature, which will be discussed in more detail later on.

Dr Christopher Koper followed up the 1989 Minneapolis Hot Spot experiment by reanalysing data from 17,000 recorded observations of police patrol with the specific purpose of measuring residual deterrence and identifying the optimal time that patrol officers should spend in a hotspot. Koper (1995) used survival analysis to identify that each additional minute of time spent patrolling a hot spot resulted in a 23% increase in the amount of time before crime or disorder took place after officers had left. Survival time relates to the amount of time between the officers departure from patrolling the hot spot to the point at which a criminal or disorderly event occurs. Koper found that 10 minutes of patrol dosage during each patrol visit to a hot spot

was the critical threshold; this was the point at which residual deterrence benefits were greater than those generated by an officer driving through the hot spot. Koper found that the optimal patrol time in a hot spot was 14-16 minutes and that after the 15 minute threshold had been passed there were diminishing returns in crime reduction.

We know from this research that increased time did not lead to greater improvements in residual deterrence. This phenomenon is often referred to as the "Koper curve" as graphing the duration response curve shows the benefits of increased officer time spent in the hot spot until a plateau point is reached at around 15 min (see Koper, 1995). Although this contribution to hot spots policing is significant there is little discussed in relation to the frequency of visits to hot spots which is a potential weakness of this analysis.

The first real test of the 'Koper Curve' (Koper, 1995) saw an agency led approach by the Sacramento Police Department where the recommendation that police officers randomly rotate between hot spots, spending about 15 minutes patrolling in each (Telep, Mitchell & Weisburd, 2012) would be tested. The results in Sacramento show statistically significant reductions in crime and disorder over the 90 days the experiment was conducted where officers patrolled hot spots roughly every 2 hours between 09.00am and 01.00am seven days a week. Sacramento officers were also subject of a high degree of control where they were instructed to visit a certain number of hot spots in a set, randomised order. This was in stark contrast to the approach taken in Minneapolis (Sherman & Weisburd, 1995) where the general approach was to generally increase time spent on patrol. The aim of this approach in Sacramento was to ensure treatment as assigned using what we might term 'bounded decision making' or what as Simon (1957) defined as 'bounded

rationality' where an individual's decision making is only as good as the information available at the time. Therefore providing officers with a set route or plan of patrol provides more information and a set of instructions for officers to follow when making a decision where to patrol.

As well as the Telep, Mitchell and Weisburd (2012) study in Sacramento there have been other classic experiments conducted in the United Kingdom which have focused on the recommendation from this and the Koper (1995) analysis of the Minneapolis (Sherman & Weisburd, 1995) experiment. In 2011 London Underground platforms were subject to 1 hour of directed patrol each day, where the hour of directed patrol was split into 15 minute patrols conducted four times per shift. Again, the preliminary analysis of this study indicated that there was a 25% reduction in crime on treatment platforms compared to control platforms (Braga, et al. 2012).

The Symbolic Quantification of Power: A Randomised Control Trial (Ariel, 2015) describes the use of Police Community Support Officers (PCSO's) as "sentinels" in hotspots acting as crime preventers or guardians to reduce the opportunity of committing crime. PCSO's are non-warranted officers with limited police powers compared with their warranted police constable colleagues, their primary role being to provide reassurance, engagement and a visible on street presence to their local community. This experiment used PCSO's to deliver 15 minute patrols three times between the hours of 3pm and 10pm in treatment hot spots. Tracking of PCSO patrols using Global Positioning System (GPS) revealed that the integrity of delivery was not maintained, in fact, the overall mean patrol dosage delivered each day was 37 minutes with the mean number of patrols 4.7 per day. The findings here suggest that although calls for service were reduced by 40% and crime by 28% over a twelve month period it is the additional number of patrols

(frequency) rather than additional minutes (duration) that lead to deterrence (Ariel, 2015). This is a significant departure from the widely accepted paradigm that deterrence in hot spots is likely to be achieved by increasing the duration that officers spend in a hot spot only.

The Peterborough 'Pop-Up' finding of shorter more frequent patrols leading to deterrence of crime and disorder, theoretically at least, makes perfect sense. After all, if we refer back to the definitions provided at the beginning of this paper the more often an officer patrols a hot spot, the more initial deterrence is created and increased number of patrols should result in less time for residual deterrence to decay to the point at which a crime or disorder event occurs. The Peterborough study is not on its own in testing 15 minute patrols conducted 3 times each day in hot spots of crime and disorder. A similar experiment in design and methodology was conducted across a policing unit of south Birmingham (Ariel, 2014 – mst/ebp conf. slides for ref) using 50 control and 50 treatment hot spots. The overall reduction of crime and disorder at medium and high hot spots was 40%, however at low hot spots of crime and disorder there was a backfiring effect which saw a considerable increase in demand. However, in the majority of all hot spots policing experiments the findings indicate that overall more patrol leads to overall less crime (Ariel, 2014).

Size and Identification of Hotspots

A hot spot is a geographic space in which there has been an increased concentration of crime, over time, per square foot relative to other space in the larger jurisdiction (Sherman, 2015). This is a very broad definition that answers the simple question; what is a 'hot spot?' However, is it clear that relative to each police

agencies geography, its population and history of crime and disorder in that place, hot spots look and feel very different across the place based policing spectrum. 'Hot spots' or areas of land subject to disproportionate amounts of crime and disorder are described in the rich literature relating to hot spots as street segments, blocks, unique addresses or intersections or in more recent UK studies[1] are defined by a certain size and number of crimes.

It is important also to be clear in our approach to place based or hot spots policing of what is not a hot spots of crime, this is particularly important when assessing the number of resources available to an agency to actually carry out targeted hot spot patrols. Weisburd, Groff and Yang (2012) discuss the significance of focusing resources into smaller 'micro' locations in contrast to larger areas, a common sense approach when considering deterrence theory, which will be discussed later, and the Sherman (2014) definition of a hotspot; put crudely a place that the police can see the public and the public can see the police.

They also warn against targeting larger geographic areas of crime and disorder as they may experience 'ecological fallacy' where finely scattered resources do not focus on those specific locations that drive police demand. In this research the definition of a hot spot is clear; more than 75 crimes and calls for service that relate to anti-social behaviour must have occurred within the past two years and be contained within one of the 150m x 150m grids that cover the West Midlands Police area.

[1] Recent UK studies such as those in Birmingham (Sherman & Ariel, 2014) and Peterborough (Ariel, 2015) and London (Ariel, 2015) have all used the methodology that officers will conduct 3 random 15 minute patrols during late shifts within hot spots.

The phenomenon that crime and disorder is intensively grouped in small areas of space led to the discovery of the ‘law of concentration of crime in places’ as described by Weisburd, Telep & Braga (2010). If places were offenders then we would be describing what makes the ‘power few’ offenders so powerful or what has been translated as the 80:20 rule in which 20% of the population are responsible for 80% of crime outcomes (Kock, 1999). This rule of the ‘power few’ holds true in the context of places where relatively few hot spots produce most calls to the police, in the case of Minneapolis this figure was reported at 50% of calls in just 3% of places (Sherman, Gartin & Buerger, 1989).

In the respect of this law of concentration of crime in place (Weisburd, Telep & Braga, 2010) it would be understandable to assume that identification of hot spots is a fairly simple process; one in which crimes and calls for service data is simply run through a mapping system which informs an agency of where they ought to focus their directed patrols. However, this is not the case and as Buerger, Conn and Petrosino (1995) discuss there are three main issues to overcome when operationalising the theoretical definition of a hotspots into meaningful police outputs. They categorise these issues as; the human techniques used in assigning crime activities to location, attribution of crime and calls for service to public or private locations and the conflict of boundaries that are generally distinct in computer mapping but imperceptible in field operations.

The literature also describes a wide spectrum of what hot spots policing initiatives have targeted in terms of crime and disorder. Many of the early studies (Sherman & Weisburd, 1995; Kelling, et al. 1974) are U.S centric in terms of what agencies across the states describe as ‘hard’ or ‘soft’ crimes (add footnote here to explain this in more detail) and there is clearly a very different culture around the

possession and use of firearms in criminal offences to consider. Whereas U.K based studies in recent years have focused the deterrent effect that hot spots patrols create on what is broadly described as ‘Street Crime’ which includes property crimes such as burglary dwelling and criminal damage. However, the culture and reform sweeping through U.K policing during the past five years translates to greater emphasis on offences against the person; commonly labelled as ‘public place violence’ which includes the spectrum of assaults including all domestic related assaults that take place in public.

Most recently U.K studies in both Birmingham and Peterborough have used grid squares of 150 metres or polygons with a radius of 150 metres. Why? Because the purpose of targeted foot patrol in these studies was to increase visibility and accessibility to large audiences (Ariel, 2015). This approach allows officers a degree of discretion in where they patrol within the hot spot; most U.K hot spots are not grid like in their layout but more a disordered jumble of linked streets, roads and cul-de-sacs. In addition to the issue of U.K geography and officer discretion (the latter being discussed in more detail later on) the methodology of using a street segment approach in the U.K is more challenging as the number of identified hot spots would be diminished and the Sherman & Weisburd (1995) approach of seeing and being seen would also suffer. Despite the varying methods described in the literature in how hotspots are identified it appears that the size of a hot spot does not change the overall pattern of the concentration of crime events in hot spots compared to the surrounding area (Ariel, 2015).

It holds true then that the concentration of crime in place remains stable over a period of time, in the case of the Birmingham and Peterborough studies as with this research a hot spot is identified using the past two years crime and demand

data. As the West Midlands Police, alongside U.K Policing PLC, move towards 2020; which will signal the end of a decade of austerity, reform and cultural shift in policing it is perceivable that the only kind of patrols that the public can expect to see are those targeted at hot spots of crime and disorder[2]. What this research will not cover is the long term study of 'cool spots' of crime and whether they also remain stable over time. If we accept the general rule for hot spots and apply that to the rest of the geography in an agency which is generally cool or has been for a stable period of time then this may pave the way for an open narrative and expectation setting of what the so called 'bobby on the beat' will look like within a fairly short space of time.

Diffusion & Displacement

Walk into any briefing room of front line police officers or police community support officers in the U.K who are tasked with directed hot spots patrol and at least one officer will raise the issue of "moving crime around the corner." Culturally this thought process may stem from a lack of understanding and, most certainly in recent times, the reduced quality of training provided through learning and development. However, the Braga et al. (2012) review of hot spots policing effect on crime suggests that crime control benefit effects were more likely to be observed than crime being displaced. This review also notes that the displacement may be very difficult to detect because the way in which crime manifests itself elsewhere has the potential to be hugely diverse (Barr & Pease, 1990). Acknowledging that displacement may be difficult to track is a useful starting point, however the evidence

[2] In patrol terms there is also the visibility provided for by uniformed front line response officers whose primary role is to attend 'in progress' calls for service but these officers are spread over entire policing areas as opposed to small hot spots and, although generally briefed on demand reduction areas across U.K forces, are focused on reactive policing and not on reducing crime and disorder.

of displacement to date must also be championed given that the overall effects of hot spots patrols within the Braga et al. (2012) review show a noteworthy cooling down of targeted hot spots across studies. Only three studies included in this review (25 studies included, 17 of these studied crime displacement or diffusion of benefits) reported spatial displacement of crime into the area surrounding hot spots.

In addition to the Braga et al. (2012) studies reporting a diffusion of benefits there is also a U.K study of industrial towns (Haywood et al., 2009) that measures displacement following a place based problem solving approach of adding alleyway gating between terraced housing stock. This study did so using a displacement measure of up to 1000 metres (0.62 miles) radius from the centre of the alley gate. Considering that offenders travel for miles on foot and even further when using vehicles so this may be a limitation to this and other studies that do not consider the wider scope of an offenders journey into and out of a hot spot or crime location.

This study, as described in the methodology will measure diffusion of crime control benefits to the surrounding area but will be limited to the 150 metre by 150 metre grids that immediately surround the hot spot itself. It may be possible post research to conduct wider analysis in this area as it is acknowledged that this is a small area to measure diffusion of benefits and more work will need to be done to consider officers routes in and out of hot spots. As an agency developing a future strategy for targeted hot spots patrols this is an extremely important issue to track and report and one that has the potential to win over those parade room doubters or cement in their minds that this tactic is not valid.

Measurement of Crime Severity

It has long been established in the history of policing that crime is recorded, whatever its crime type and no matter how serious the harm, as a single count; one criminal damage is one crime and equal in number to one murder. Each single unit of crime is included in the mass of crimes data and totalled to produce a list of the most prevalent crime types which then influences the focus of an agencies resources towards the most common crime type. However, what is becoming clear at a national level, in the U.K at least, is the risk and threat of crimes that cause the most harm; domestic violence, public protection offences and serious violence (including robbery) now headline tactical meetings followed by the traditional acquisitive crime types such as burglary and theft from motor vehicles. Although the lens of U.K policing is now focused on crimes that cause more harm there is no single measure in use by police that separates out crime counting.

Academics in the past have attempted to assign severity to crime, Sellin and Wolfgang (1964) surveyed a broad range of groups that included judges, students, community members and police officers asking them to rank crimes on a scale of 1-11; 1 being the least serious and 11 being the most serious. Although this work was subject to considerable criticism (Bland, 2015) of its sampling methodology Wolfgang (1985) widened the ranking questions to 60,000 survey respondents amending the scoring to a range between 0.2 and 72.1. In both 1964 and 1985 the surveys found general levels of agreement on the severity of crime types.

Sherman, Neyroud and Neyroud (2014) argue that not all crimes are created equal and have proposed a successor to the work began by Wolfgang and Wolfgang and Sellin. Sherman, et al. have developed the Cambridge Crime Harm Index which

converts each single count of crime into a value based on the number of days imprisonment that the crime is equal to. The measure used to assign a value here is taken from the U.K's sentencing guidelines, importantly the starting point for a sentence rather than averages of actual sentences passed down. Sherman, et al. point out in their proposal that using the sentence starting point is desirable as this excludes every other possible variable associated with an offender's antecedence that would influence the actual sentence. Using this as a measure therefore provides a consistent measure of harm that could be used to assign harm to places, offenders and victims. However, as Bland (2015) points out, although this is a robust measure of assigning harm the external validity to police agencies outside the U.K may be limited although offer a structure to build on.

Hot spots of crime and disorder in the U.K focus on street level crimes, these include many property or acquisitive crime types but importantly include offences that attract a greater degree of harm when subject to the Cambridge Crime Harm Index. There is growing evidence on the testing of this index in the U.K, Bland (2015) used the Cambridge Crime Harm index to research escalation of crime severity in domestic abuse and many on-going research experiments are using the index as a measure to enhance traditional crime counts and put further context and understanding behind the impact of harm. This study will utilise the Cambridge Crime Harm Index as an outcome measure and become the catalyst for its implementation agency wide.

Summary of Literature Review

This review of the literature relating to hot spots policing has specifically targeted areas most relevant to the scope of the research reported on in answering the question of what matters most in hot spots policing; time spent or frequency of visits?

Hot spots policing has been tested in dozens of rigorous tests (Ariel, 2015) and while the evidence keeps growing, the benefits of targeting police in time bound, random patrols into hot spots clear. The Braga, et al (2012) review of hot spots policing meta-analysis of key reported outcomes reveals a small but statistically significant mean effect size that favours the effects of hot spots policing in reducing crime in treatment places when compared to control places. The evidence also indicates that whilst hot spot policing can 'cool down' hot spots, crime is not spatially displaced to adjacent areas (Weisburd, et al 2006).

Definitions & Theories

Bottoms and Von Hirsch (2010) define deterrence as 'inducing avoidance of a given action through the threat of adverse consequences.' Deterrence is well covered in criminological literature and its origins owe more than a passing nod to the classic Greek myth and legend, the story of the sword of Damocles. This fourth century B.C tale tells us of a king ordering a braggart to sit under a sharp sword hanging by a single thread over his head for the duration of a dinner. If the braggart began to brag the king would have the thread cut leaving the braggart dead. The theory from this story was contextualised by Bentham and Beccaria who further developed deterrence as a theory in the 18th century (Akers & Sellers, 2007). Theory

states that offenders will make a choice not to commit crime based on a pleasure versus pain playoff; if the punishment outweighs the pleasure of committing the crime then a decision will be made not to commit that crime. The key elements of deterrence are summarised as certainty (the likelihood of apprehension), severity (of punishment if apprehended) and celerity (the swiftness in delivery of punishment). Considering the question this experiment set out to answer; which type of patrol maximises deterrence theory suggests that shorter more frequent visits may induce a fear of greater certainty of being apprehended.

Deterrence Dosage

Deterrence dosage can be described as the amount of time police spend on visible patrol in a location. This paper describes two treatments of differing durations, 5 minute patrols versus 15 minute patrols, which total the same overall dosage of 45 minutes each day in terms of time spent on patrol. What effect will the way in which this dosage is delivered have on overall deterrence? Again this is not an issue that the Braga (2012) review of hot spots considers, however there are recent studies that address specific testing of the Koper Curve (Koper, 1995) where hot spots studies in Sacramento (Telep et al, 2012) and Peterborough (Ariel, 2015) have tested dosage of 15 minutes in treatment hot spots and policing as usual in control hot spots., these are described in more detail later on.

Rational Choice Theory

The occurrence of deterrence theory is explained by rational choice; there is a body of research that supports the premise that rationality exists in an offenders mind when they consider committing a criminal act or omission. Cornish and Clarke

(1986) describe a utilitarian belief that offenders are reasoned actors who weigh means to ends, costs to benefits and as a result make rational choices. Rational choice is intrinsically linked to Routine Activities Theory which was developed by Cohen and Felson (1979) who argue that crime is normal and occurs as a result of opportunities available to a potential offender.

Routine Activities Theory

For a personal or property crime to occur there must be a convergence in time and space of three elements; a motivated and willing offender, suitable targets or victims and capable guardians of persons or property (or the lack of them) (Cohen and Felson, 1979). Subsequent work by these authors describes how the police are not the only capable guardians and that ordinary citizens are more likely to deter crime, indeed this marries up with a key Peelian Principle[3] that the public are the police and the police are the public. As the evidence becomes more sophisticated in relation to hot spots studies and their use of Sherman's (2013) Triple T (Targeting, testing and tracking) methodology the premise suggested by Cohen and Felson appears to become less valid when there is such persuasive evidence that hot spots policing has a noteworthy effect in reducing crime and disorder.

[3] Sir Robert Peel founded what is known today as the Metropolitan Police Service in 1829, one of the 9 key founding principles of this ethically correct service was; To maintain at all times a relationship with the public that gives reality to the historic tradition that the police are the public and that the public are the police, the police being only members of the public who are paid to give full-time attention to duties which are incumbent on every citizen in the interests of community welfare and existence.

In conclusion although the evidence that relates to hot spots policing has grown there are gaps that require further research. As Sherman (2015) points out, what we know is always provisional and subject to revision by further research, this is true of hot spots policing as there are clearly different challenges in terms of implementing hot spots policing across agencies. The studies covered in this literature review have examined optimal time based on Koper's (1995) research, however, they have not specifically set out to examine optimal frequency of visits nor have they considered the effects of delivering that patrol time in shorter stays; this study will address this gap.

Methods

The sections that follow lay out the methodology roadmap of this experiment along with its implementation. These sections will describe the setting of hot spots, the data sources used for selection of hot spots and the criteria used along with the challenges of using geo-fencing to track officers in a police service that did not have the ability to use this technology to so prior to this experiment.

Setting & Context

This experiment was conducted in Birmingham, UK, commonly referred to as the 'second-city' in reference to its standing compared with the capital city London. The West Midlands Police Service covers the Birmingham, Black Country, Wolverhampton and Coventry areas currently having a structure of 10 Local Policing Units (LPU's) responsible for providing response, neighbourhood and investigative policing services to their local community. In turn the greater Birmingham area is covered by four LPU's and the setting for this experiment, Perry Barr, covers approximately a third of Birmingham West & Central (BWC) LPU where one Inspector, four Sergeants, 47 Constables and Police Community Support Officers are responsible for delivering local policing.

Perry Barr is located to the north-west of central Birmingham in the heart of the West Midlands Police geographic force area. Perry Barr is a 'Constituency' comprising four smaller 'Ward' areas where Neighbourhood Policing Teams (NPT's) are responsible for community engagement, directed patrols and problem solving amongst other duties. Birmingham has a growing population with over 1.1 million residents (ONS News Release, July 2012) and Perry Barr is one of the largest

districts in Birmingham in both geographic size and population with approximately a third of the population being under the age of 24. Perry Barr as a constituency is the most culturally diverse policing district within the West Midlands with black and minority ethnicity (BME) groups accounting for more than 50% of the population. This statistic means that Perry Barr has a higher BME community that the city wide average and more than five times the national average (Birmingham City Council Data, 2013). The four wards within Perry Barr are; Perry Barr, Oscott, Lozells & East Handsworth and Handsworth Wood. Although there are four distinct ward areas there are only three NPT's responsible for neighbourhood policing these with Perry Barr & Oscott Wards being covered by one team.

Prior to the beginning of this experiment in June 2015 it ought to be clarified that although WMP had been the experimental site for Operation Savvy[4] in 2012 the lessons and evidence gained as a result had not been scaled up across the force area. A demand reduction policy for the force was in place at the time which drew on some of the Savvy methodology but there was no uniform take-up or implementation across the 10 LPU's that cover the WMP. BWC LPU was no exception to this and although the policy was released in 2014 there was no directed hot spot patrol activity taking place across the LPU including Perry Barr, the setting for the experimental hot spots. Day to day policing included priority areas for patrol set through a monthly accountability meeting (Tactical Co-ordination Group) which drew on analysis of place in terms of crimes and calls for service but did not use a hot spot methodology to identify those places; more of a dynamic forward planning based on current risk, threat and emerging trends compared to the previous 12 month period.

[4] Operation Savvy was an experimental hot spots patrol study that took place on Birmingham South (BS) LPU between 2012 and 2013 showing on average 40% reductions in street crime and anti-social behaviour calls for service across 40 treatment hot spots in comparison to 40 control hot spots.

As the lead for this research I was, to a degree, bound by the constraints of both my rank at the time of conducting this experiment and my role as an NPT Sergeant. To put this clearly into context I moved from Birmingham South LPU to BWC LPU in February 2015. I found that there was no hot spots policing taking place and set out to implement a change in patrol culture for the benefit of the community. This involved 'selling' the idea of hot spots policing not only to the leadership of the LPU and WMP but also to my peers and the Constables and Police Community Support Officers who were going to deliver these patrols (many of whom were clearly sceptical that; 1) I was new to the LPU and in their eyes unproven and 2) an advocate of evidence based policing). Although it would have been advantageous to scale this experiment up across the entire LPU it was clear that I would have far greater influence and control over one quarter of the LPU rather than the LPU as a whole.

Experimental Design

The planning for this experiment began in March 2015 in collaboration with the Criminology Department at The University of Cambridge, the BWC LPU leadership team and a small research team who would lead and analyse the experiment. Hot spots identification by the WMP geo-spatial officer had begun some months prior, in fact in October 2014 the first release of hot spot data went to all LPU's along with an 'Ethical Demand Management' policy document where LPU's were required to map all hot spots on the NPT briefing system and commence patrols; this will be discussed further in both implementation and discussion sections. It is worth noting that although hot spot data had been released with instructions there had been no uptake of patrols across the LPU until April 2015.

General Hypothesis

The hypothesis for this small scale randomised control trial is that shorter more frequent patrols of hot spots will result in greater deterrence of street crime and ASB calls for service. Shorter more frequent patrols being 5 minutes in length conducted 9 times during a late shift compared with longer less frequent patrols of 15 minutes conducted 3 times during a late shift. Will creating more frequent initial deterrence and leaving less time for deterrence decay to kick in cause there to be less crime? Research to date suggests that the threshold of patrol time required to create a lasting deterrent effect is around 10 minutes (Koper, 1995). In contrast, however, there is now emerging evidence that suggests the frequency of visits may have more of an influential (Ariel, 2015) role.

Hot Spot Identification

The methodology used to identify hot spots of crime and disorder was similar to that used in both the Birmingham (Sherman & Ariel, 2014) and Peterborough experiments (Ariel, 2015) where hot spots were geographically no greater than 150 metres in radius. This was already a work in progress by WMP where to map hot spots across the WMP force area, which covers 348 square miles and 2.8 million residents, a 150 metre x 150 metre grid was placed over the mapped area where public generated crimes and calls for service were counted within each grid. Operationally this has two advantages for the WMP of providing a manageable area to complete patrol and making an impact on demand whilst removing every single boundary line between sectors within the LPU along with ward boundaries which have traditionally been a barrier to identifying crime patterns and trends.

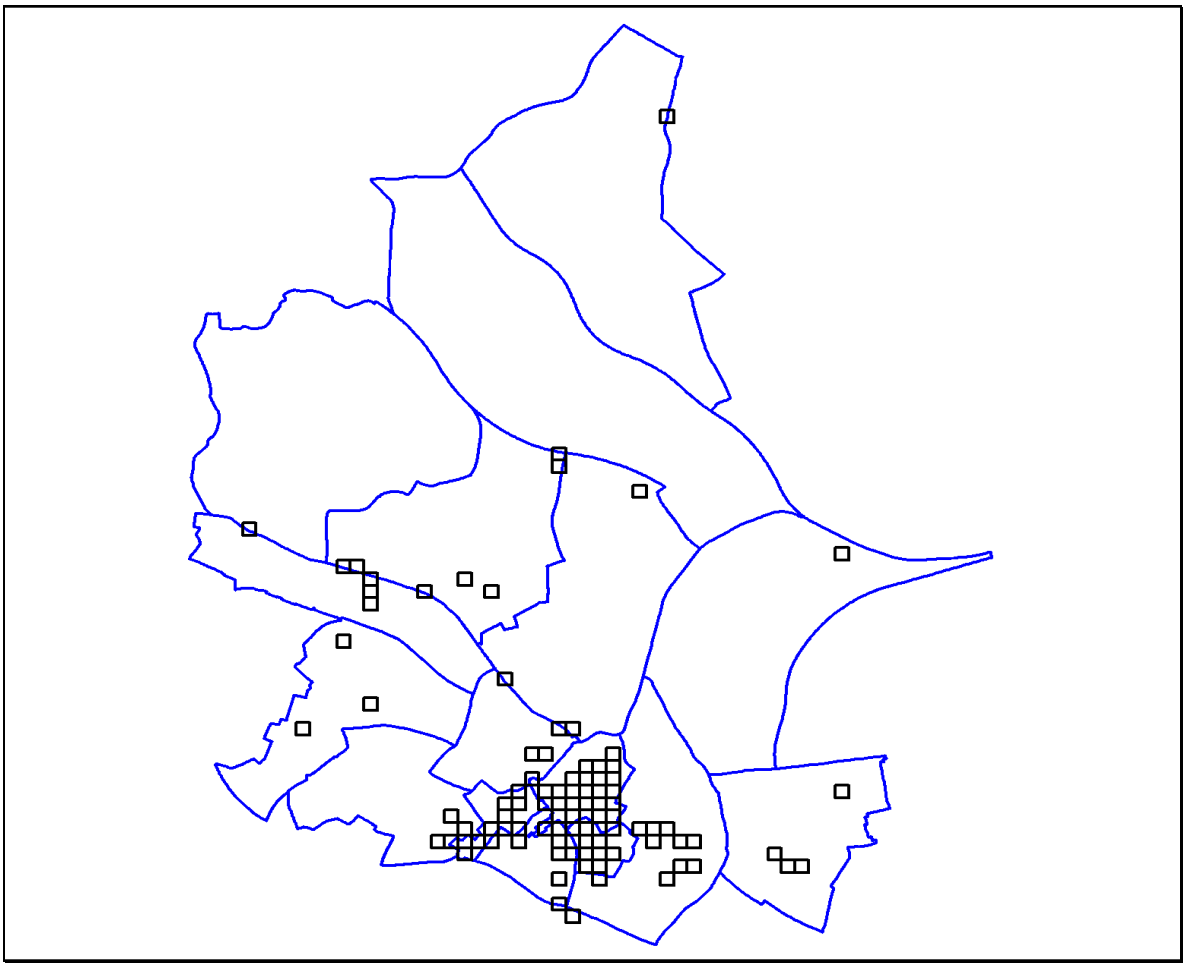
It is worth noting that the demand experienced by BWC LPU, which covers the city centre of Birmingham and its night time economy, is markedly higher than that experienced elsewhere in the WMP force area. Operation Savvy in 2012 was sited on Birmingham South LPU where the threshold level of calls for service for a hot spot to be recognised as such was 50 public generated crimes and calls for service in a 24 month period. When applying this threshold level to BWC LPU over 80% of the central landmass of the LPU became eligible for patrol. In order to maximise targeted patrols in hot spots the agreed threshold level of public generated crime and calls for service was agreed at 75 in the same time frame.

In mapping hot spots in this way, a definition of a hot spot was created within WMP for BWC LPU with the following criteria;

1) a grid no bigger than 150 metres x 150 metres;

2) with no less than 75 victim generated street crimes and ASB calls for service in the past 24 months.

Figure 1: All identified Hot Spots across BWC LPU (April 2015)



Although there are different methods available to identify a hot spot they usually support the law of concentration of crime in place. This means that hot spot maps have the potential to effectively guide police action (Weisburd et al., 2012). This size of hot spot (150m x 150m) also allows officers the greatest opportunity to have the maximum effect in terms of visibility and accessibility, especially as those officers held to account in WMP for hot spots policing are NPT officers who predominantly conduct foot patrols.

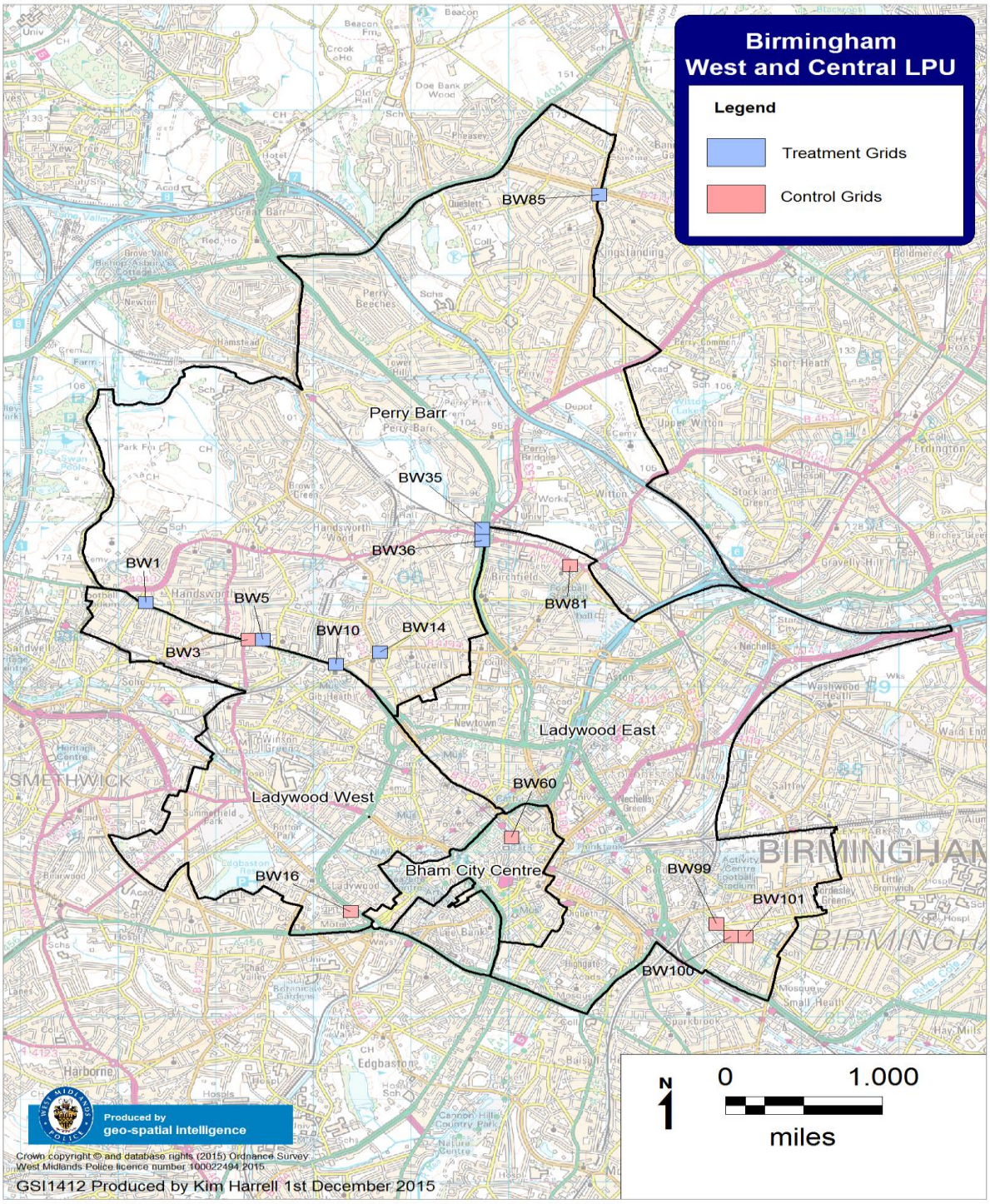
Hot Spot Selection

Phase 1 of this experiment was the initial roll out, in April 2015, of hot spot maps to all front line NPT Inspectors and Sergeants with clear guidance from Senior Leaders around expectations; filter out those hot spots that are driven by specific issues relating to known offenders or repeat caller addresses, map the remaining hot spots and track patrols using self-reported feedback from officers. Effectively this created a simple before-after level 2 Maryland Scale comparison of hot spots prior to any directed patrol between April 2015 and June 2015 when the second phase (RCT) commenced. This comparison will not be reported on in detail within this thesis, however it is important to understand the context of the experimental hot spots prior to the start of testing two intervention types, i.e. 5 minute patrols versus 15 minute patrols.

Phase 2 of this experiment began in June 2015 where 7 hot spots identified across Perry Barr Sector would become treatment areas for both 15 minute and 5 minute patrols. Control hotspots were identified by selecting 7 pairs of matched hot spots[5] from the wider BWC LPU where one of each pair was randomly chosen to act as a control. This provided a total of 14 hot spots; 7 treatment (for two treatment types) and 7 controls.

[5] Treatment and control hot spots were pair matched against total demand. Treatment hot spots were pre-selected from a total of 10 eligible hot spots across Perry Barr, 3 hot spots were given a rationale as to why they would not be included for treatment (i.e. demand within the hot spot was already being dealt with by other problem solving tactics) leaving 7 hot spots for treatment. The remaining hot spots from the wider LPU were then matched to treatment hot spots based on total demand. Of note hot spot BW3 was matched as a control hot spot but falls adjacent to a treatment hot spot; given the geography of the area and the road layout there was no continuous line of sight between these grids so this remained a control.

Figure 2: Treatment & Control Hot spots BWC LPU.



Outcome Measures

Each hot spot was identified using victim generated street crimes and ASB calls for service over a 24 month period. Street Crime in WMP is classified as Burglary Dwelling, Burglary Other, Public Place Violence with Injury (VWI), Robbery,

Theft from Person and Vehicle Crime. Notably this excludes Theft Shops and Stalls, Theft Other and Bilking[6], the crime types included were those that will be impacted on the most by targeted and visible patrol. Police generated crimes and ASB calls for service (or police generated logs) are described by Sherman and Weisburd (1995) as outputs rather than treatment outcomes so are excluded from any data collected during the course of this experiment.

The same outcome measures of victims crimes and ASB calls for service were collected during the course of this experiment where changes were compared between the before and after period for overall treatment and control plus the important comparison of the differences between 5 minute and 15 minute days.

The primary outcome measures collected during this experiment were public generated ASB calls for service and public generated Street Crimes. Data from the treatment period in both 2013 and 2014 was also captured to allow a year on year comparison. Crime Harm levels were calculated from recorded street crimes data as there is no current satisfactory way of converting ASB calls for service into crime harm. This was considered as part of the data analysis; however, clear inconsistencies in recording categories of ASB meant this would have been unreliable. A simple dip sample of OASIS Logs showed that the three categories used to close of ASB calls for service (Personal, Nuisance and Environmental) were used widely and inconsistently across similar incidents; all ASB is reported as these three categories combined.

[6] The offence commonly known in the U.K as 'bilking' refers to what the Theft Act 1978 defines as 'Making Off Without Payment'; where payment for goods or services (in this case fuel from service stations) is expected 'on the spot' and a person dishonestly fails to do so (Also commonly referred to as theft of fuel).

Intervention Types

Following an initial meeting in March 2015 and review of all hot spots across BWC LPU a recommendation was made to the leadership team that identified hot spots should be patrolled for 15 minutes three times each late shift by NPT's. It was agreed that all sectors of BWC LPU would implement these patrols and become business as usual. However, it was clear that experimenting across all sectors would prove overwhelming[7] for both officers who had not conducted this type of patrol previously and for such a small research team (consisting of a Police Sergeant from Perry Barr Sector and 2 Analysts who would conduct this experiment on top of their normal duties). There is much to be said about the need for champions or enthusiasts of evidence based policing to emerge at all levels across any change piece, this experiment being no exception. It was clear that whilst there was an appetite for the implementation, experimentation and refinement of hot spots policing on BWC LPU there were very few officers across first and second line supervision ranks that showed clear passion and drive for prioritising hot spots patrols.

The main purpose of this experiment was to test the hypotheses that more frequent, shorter visits to hotspot areas of street crime create a greater reduction in those crime types compared with longer less frequent patrols such as those tested previously in Sacramento (Telep et al., 2011), Birmingham (Ariel, 2014), Peterborough (Ariel, 2015) and London (Ariel, 2014a add footnote to explain underground exp). In each of these four experiments the dosage of time spent on patrol in a single hotspot was 45 minutes each day during a late shift; typically

[7] In the summer of 2015 the West Midlands Police were heavily committed to creating and developing the future vision and structure of policing for the force with business partner Accenture. At this time there were no additional resources to draw on to assist in a wider implementation in addition to a lack of capacity within the WMP2020 project to bring this RCT under their governance.

between the hours of 3pm and 10pm, where 45 minutes being split into three 15 minute visits to replicate Koper's finding in 1995.

In order to test this hypothesis 150 consecutive days were selected and allocated a number from 1 to 150. These numbers were then entered into an online random number generator where the numbers 1 and 2 were randomly assigned to each numbered day. This provided 75 days assigned to the number 1 and 75 days assigned to the number 2. Those days assigned number 1 were treated with three 15 minute patrols between the hours of 2pm and 11pm and the days assigned to the number 2 were treated with nine 5 minute patrols between the same hours.

On each of the 150 days the duty late shift NPT received a brown A4 envelope containing a briefing pack for those officers tasked with patrolling hotspots. This included a double sided A4 sheet stating the date, team expected to be on duty and the type of patrol to be conducted, i.e. 9 x 5 minutes or 3 x 15 minutes (see appendix 1). The packs also included a colour map of each hotspot location and activity sheets for officers to complete as they patrolled. The colour maps provided to officers provided them with not only a map with the specific area to be patrolled but included the top three crime and antisocial behaviour (ASB) locations by street address along with a breakdown of crime and ASB types.

The briefing packs provided to officers were an important part of the implementation of this experiment as they also contained paper based activity sheets to manually record the policing outputs that took place during individual patrol of a hot spot. This sheet was also a double sided sheet that asked officers to record whether they were single or double crewed, on foot or bicycle patrol and provided a range of activities that would normally take place during patrol. The range of

activities on this feedback sheet were suggested by officers during the two week pilot to test geo-fencing capability and the ability to use the data to provide regular visual feedback to officers after every week of patrols had been completed. Although hot spots were recorded on the WMP briefing system specifically designed to be used by NPT's it was clear that this system was not used by NPT's across the experimental area and that culturally there was a step change required to achieve this which may have been too much for officers delivering patrols to deal with. This was one of the main considerations when deciding to use paper based briefings, and, with the importance of maintaining treatment as assigned each day to have both in place provided a safeguard.

Activity Analysis: Patrol Outputs

One of the objectives of this experiment was to capture patrol outputs of both warranted constables and non-warranted police community support officers during both types of patrol; a key element to understand and consider when comparing two differing patrol types. There is a gap in the literature around hot spots policing that does not cover officer outputs in any satisfactory detail, although Ariel (2015) does make a distinction between patrol outcomes of warranted and non-warranted officers. However, no study contained within the literature review for this paper conducted a detailed activity analysis of officer outputs whilst on patrol.

This is an important area to understand, whether a police agency has a shrinking workforce or not. The implication of patrol outputs is as significant as the observations made by Ariel (2015) where non-warranted police community support officers (who, in the UK, essentially have the appearance of police officers) have been used to significantly reduce demand in hot spots. These officers are civilian

support staff members in uniform who have no powers of stop and search or arrest[8] and were brought into being in the U.K in 2002 as part of the government of the times pledge to tackle anti-social behaviour and provide a more visible presence across neighbourhoods.

If targeted patrol outputs in hot spots cause a reduction in demand, as we witnessed in Birmingham (Sherman & Ariel, 2014) and Peterborough (Ariel, 2015) and patrol activities do not require specific powers or arrest, detention or search this becomes even more important when considering the future roles of these officers and greater involvement of 'Active Citizens'[9].

During phase 1 of this experiment officers were asked to make a note of their patrol activities and feedback in order to categorise activities taking place during hot spot patrols. From an implementation perspective this was a worthwhile exercise to conduct as officers began to feel more involved with the experiment and were able to influence a part of the research.

In total there were 12 categories that officers were asked to report on; offender management visit or contact, dealing with pedestrians, stop search of pedestrian, dealing with motorists, stop search of motorist, arrests made, dealing with calls for service ordinarily dealt with by response officers (including being called away from the hot spot to deal), dealing with an incident in view, intelligence gathering, community engagement, visit to top 3 demand location (based on crime)

[8] Section 24A(2) of the Police & Criminal Evidence Act 1984 states that any person can arrest another when they either know an offence has been committed and they reasonably suspect the person to be guilty of committing the offence or they have reasonable grounds for suspecting someone is in the act of committing an offence.

[9] Active citizens (WMP2020 TOM) are included in the WMP vision of policing in the year 2020 where the public are empowered to play a stronger role in problem solving, i.e. becoming more capable guardians of their area through greater engagement in Neighbourhood Watch Schemes.

within hot spot and finally visit to top 3 ASB call for service location[10]. There were four additional categories added for officers to report on; whether they were single or double crewed and whether their patrol was on foot or using a bicycle.

Diffusion of Benefits

To work out whether crime within each treatment hot spots is significantly higher than the crime outside the hot spot the average level of street crime and ASB was taken from surrounding grids and a confidence interval calculated for comparison with the average levels for treatment hot spots. If the levels of demand in the hot spot were not significantly greater than the surrounding area in 2015 (since patrols began) this would give an indication that crime or ASB may have been dispersed to surrounding area.

Data Sources

During the course of this experiment a number of data sources were used to report results of both patrol types and patrol outputs. Data sources were used to initially identify eligible street crimes and ASB calls for service, map hot spots based on this data and to allow the tracking of officers using GPS technology.

Reported crimes are recorded by WMP using the 'CRIMES' recording and enquiry system which is used to input and manage all recorded crime within WMP

[10] To ensure consistency in reporting patrol outputs officers agreed on the following definitions where there was ambiguity around the category title; dealing with pedestrian or motorist: person or vehicle of policing interest relating to crime, disorder or intelligence; community engagement: an unfocussed encounter with a member of the public not of policing interest; visits to crime and demand locations: physical entry of shops, micro-locations or contact with repeat victim.

boundaries. All eligible street crimes[11] were pulled from this system for the 24 month period ending April 2015 and available to be pulled from the CRIMES data base into the WMP mapping software 'XC MAPPING.' It is worth noting here that although there is much inconsistency across the current 43 forces of England & Wales in crime recording integrity, WMP have been highlighted as an 'outstanding' force by HMIC (Her Majesty's Inspectorate of Constabularies) for their crime recording integrity of crimes, non-crimes and calls for service (HMIC, Crime Recording: Making the Victim Count, 2014).

ASB calls for service are recorded by WMP using the 'OASIS' Command and Control system which is used by all contact management staff across the service to log calls from members of the public that range from low level ASB incidents to emergency calls that require an immediate response. The system records incident detail and information on how the incident was finally classified, i.e. a crime, suspicious behaviour or ASB to name but a few available categories. ASB calls for service for the same 24 month time period ending in April 2015 were also pulled from

[11] Eligible offences of 'Street Crime' are classified as the following offences;

- Burglary Dwelling
- Burglary Other Building
- Theft of Motor Vehicle
- Theft from Motor Vehicle
- Robbery – Personal
- Robbery – Business
- Theft from Person
- Criminal Damage – Dwelling
- Criminal Damage – Other Building
- Criminal Damage – Vehicle
- Criminal Damage – Other
- Arson
- Public Place Violence with Injury

this system and added to the crimes data to provide hot spot data for both crimes and asb calls for service (75 street crimes and ASB calls for service overall).

The granular tracking of officers when on hot spots patrols posed a significant challenge, the infrastructure in terms of geo-fencing analysis software in WMP during this experiment and at the time of submission did not exist. The WMP currently use a mapping system called ‘XC’ to track officers in real time enabling resources to be allocated to the nearest call for service and also to conduct professional standards investigations into where staff have or have not been. However, there is no system that tracks time spent on patrol in specific areas, time spent on visible patrol against time spent in police stations, numbers of officers deployed to particular areas and the correlation between police patrol outputs and crime outcomes. This is the case despite the fact that informing officers that they were being tracked and analysing the geo-fenced data during the Birmingham Hot Spots experiment was able to show that police patrol caused a significant reduction demand by around 40%.

We have heard from Sherman (2014), amongst others, in relation to the improvements made in physical tracking of police officers or their vehicles using global positioning systems (GPS) made during the past two decades. Even so, it appears that although the advent of GPS has provided Police leaders with one of the most powerful tools to track their real time or historic movements it remains the most underused method of tracking front line patrols, in a UK forces at the very least. The study site here is a second city police service, a police service that is one of the most mature in terms of implementing evidence based policing. However, prior to this experiment taking place, the only areas of the force area to be geo-fenced were large open areas that could be used to launch an air to surface missile or similar device.

In order to track officers patrolling our experimental hotspots a number of challenges had to be overcome, although WMP in 2015 have the ability to geo-fence and area of land they do not have the software package in place to efficiently analyse the quantity of data created by individual officers and car radio sets travelling through them. In fact, the only piece of analytical software available allowed a replay of a single officer or vehicles journey during their shift using their radio identifier. Using this as an analytical tool during this experiment was considered but the benefits would have been far outweighed by the time taken to replay just one officer's movements in a hotspot. A solution to tracking officers using existing technology in existence within the WMP was found, this is described in detail in the implementation section of this research paper.

Data Analysis

Data captured during patrols of the 7 treatment hot spots will be treated as population of incidents. Descriptive statistics will be used to present data in the results section using means, standard deviations and percentages in comparison. I will also use the population effect size, based on Cohen's d, using the Campbell Collaboration Online Calculator.

Data Issues and Limitations

One of the biggest culture changes and frustrations for contact management staff, first and second line supervisors since the advent of the U.K roll out of Airwave radios across all 43 forces must be the reliability of the system. A review of the

Strategic Policing Response by the HMIC (2014) stated that, “The nationally connected, secure radio network used by the police known as ‘Airwave’, provides effective connectivity in the majority of situations. However, high concentration of users and radio traffic challenge the network’s capacity. Whilst the AIRWAVE system is functional for voice and data traffic a radios affiliation to the ‘XC MAPPING’ system relies heavily on officers system 1 thinking (Kahneman, 2011) whereby they must remember to manually affiliate their radios; unlike a smart phone, that I dare say sits in every single front line officer’s pocket, which automatically sends its GPS location where GPS has been enabled.

Another limitation of the system and challenge for this experiment was the rate at which GPS data is transmitted from police AIRWAVE radios. Unlike our everyday smartphones set to ‘GPS Enabled’ mode that can track our location anywhere between every few seconds upwards (Wall Street Journal, 2011) the ‘ping’ rate for an officer’s radio is set in the WMP by their role. For example, a front line response officer has their personal and vehicle radio set to ‘ping’ at least once every 30 seconds. By contrast a front line NPT officer in the WMP will have their radio set to ‘ping’ once every five minutes. Reading the word ‘five minutes’ probably sounded an alarm in your head, just as it did to the officers designing this experiment; how can you test and track five minute patrols when those officers patrolling have radios that only send their location once every five minutes? The answer lay in negotiation with CMC colleagues who authorised the use of special call signs that were allocated to individual officers for the duration of the experiment and set to ‘ping’ once every 30 seconds.

Although this experiment set out to report on and test two distinct types of patrol across a period of 150 days the data presented here uses just 100 of those

days. During the experimental period WMP used geo-fencing software to track all resources in possession of an affiliated police airwave radio. As a result over 200,000 email 'pings' were generated and analysed using the specially created tracking tool to provide feedback to leadership and those conducting patrol. The geo-fencing element failed three times during the experimental period, twice for a matter of days and once for a matter of weeks[12].

The 100 days data is taken from 106 continuous days between 17th June 2015, when the experiment began, until the 29th September 2015 when the major geo-fencing crash occurred. 6 days were then removed where geo-fencing software had failed. One of the major factors, other than the geo-fencing crash, to keep the data set to 100 days was the fact that there are other hot spots experiments (Telep, et al., 2012) that report on 90 days experiments.

Culture & Leadership Style

Police Chief Superintendent and former Chair of the Evidence Based Policing Society Alex Murray has a rule of three (Murray, 2015) or more a prediction of three comments or barriers that some cops will inevitably voice when implementing new ways of working; Cops will say, 1) "it's been done before and doesn't work," 2) "we already do that" (but they don't track it) and 3) "that won't work here!" I can safely say that this rule of three is alive and kicking and, although frustrating in many ways, this provides leaders or champions of evidence based policing practice, as Mitchell (2014) would say 'pracademics', an opportunity to inspire by employing a transformational leadership style (Burns, 1978).

[12] IT support were tasked with identifying the root cause of the 'geo-fencing' failures, at the time of writing there has been no definitive explanation as to why it failed.

Although openness to change is part of every front line officer's professional framework there remains scepticism to new ways of working, which is human nature. Sherman (2014) states that transformational leadership is the key concept for the successful delivery of more effective hot spots patrol; inspiring officers to want to patrol more effectively and motivating them to continue improving on their own, their teams and the patrol areas performance. Creating this initial pride is not easy and takes a great deal of resilience on the part of those implementing change, no matter how big or small, yet to officers across all ranks policing is intrinsically adaptive in character (O'Connor, 2011) and its variety part of the attraction. In a time when the policing environment has never been under such a lens of scrutiny how we create initial pride and prevent pride from decaying must be a crucial aspect of leadership.

Structure & Framework

The implementation of this experiment leant heavily on 'An Integrated Theory of Hot Spots Patrol Strategy' (Sherman et al. 2014). There are ten key concepts described on how to cause effective hot spots patrol but due to the small scale of the experiment not all elements were relevant. The elements from this proposed theory used during this experiment are described as; infrastructure, targeting long term hot spots, tracking patrol in time and place, feeding back patrol in time and space, accountability for patrol and transformational leadership. In addition to the use of this theory to influence implementation, the framework for implementing an evidence based approach also drew from the four themes proposed by Neyroud (2014) of

Managerial Expertise and Judgement, Stakeholders Values and Concerns, Organisational Facts and Characteristics and finally the best scientific evidence[13].

Infrastructure & the Tracking Challenge

Infrastructure has been summarised as the capacity to produce large quantities of raw materials needed to deliver outputs to cause outcomes (Sherman et al. 2014). In this case raw materials referred to geo-fenced patrol data captured within hot spots and the capability to deal with that large amount of data in a meaningful way that could be visually delivered to those delivering patrol. Put simply in order to engage the hearts and minds of front line NPT officers involved in delivering patrol it is key to be able to show these officers the fruits of their labour to both create a feedback loop and self-monitor their compliance.

The solution to tracking and having the ability to feedback geo-fenced patrol data to officers lay in using a combination of software; firstly geo-fences were created within 'XC MAPPING' for all treatment hot spots in Perry Barr in order to replicate the precise size of each 150m x 150m hotspot. In addition to this an extra 10 metre perimeter was added to the geo-fence to take account of the 2-10 metre accuracy of GPS enabled radios. As a result of officers entering and exiting each geo-fenced hot spot a date and time stamped email with the officers' call sign, collar number and radio identifier was sent to a pre-designated email address. Each time an officer entered or exited a hotspot a single email notification was created and sent to the pre-set email account. Not only were NPT officers responsible for patrolling

[13] Each element listed in this section will be not be expanded on in detail, the references are there for the readers benefit due to limitations in word count the only section that will be expanded on at this stage is the challenge of infrastructure and tracking.

hotspots captured entering and exiting each hotspot but every WMP force resource with a GPS affiliated radio was captured providing an overall total. On average there were over nine hundred emails received each day across the seven hotspot areas that were geo-fenced. As a result there were over 120,000 separate emails that were analysed during the course of this experiment.

The next challenge was sorting through this wealth of data efficiently and quickly, to do this without the use of specially designed software a data sheet using Microsoft Excel was produced. All emails generated as a result of officers entering and exiting hot spots were exported to into this spreadsheet, however, this data was in word format where each email filled a single cell. Using Excels text to columns function data cells were converted into individual columns of data that were copied into a master data spreadsheet (for backup of all emails captured during the experimental period). Email data was then copied into a spreadsheet entitled ‘NEW GEOFENCING SUMMARY Spread sheet’ where it was sorted alphabetically by the entered exited column and then sorted by date column, earliest to latest.

This spreadsheet used a number of formulas to check the officer call sign, collar number and radio identifier against a call sign list of all NPT officers involved in delivering hot spots patrol. This then calculated the time that each officer spent within the grid for each patrol and also the team the officer worked with. This entire process took the research team minutes to conduct each day meaning that thousands of email ‘pings’ from officers patrolling hot spots could be analysed quickly and displayed graphically for the first time in WMP history.

Data within this spreadsheet (see figure 3) was displayed using tables and graphs 0that auto-refreshed each time new data was added. The data available for

officers to view was kept to 18 days (using date functions within excel), this reflected two cycles of the shift pattern worked by NPT teams involved in this experiment (3 early shifts, 3 late shifts, 3 rest days) and was a conscious effort to keep feedback to officers current and relevant.

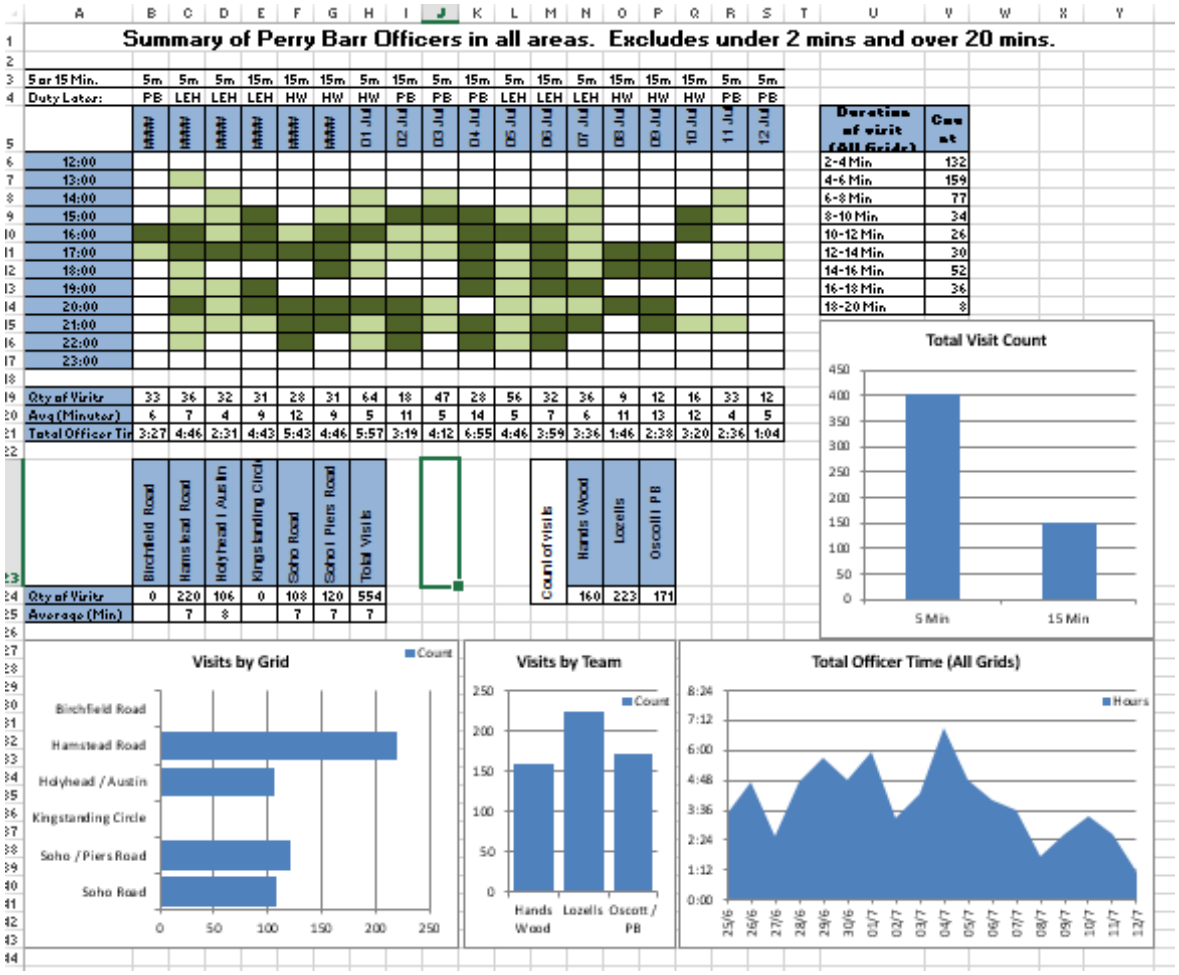


Figure 3: Example of WMP's Geo-fencing Feedback Patrol Spreadsheet

Results

Description of Data

This chapter reports on the data that answers the main questions of this paper, what matter most in hot spots policing; time spent or frequency of visits? Also reported here is associated data from this research that extends to overall street crime and ASB comparisons between treatment and control hot spots, analysis of treatment 100 days pre to post treatment, a brief summary of phase 1 findings, overview of diffusion of benefits analysis, Cambridge Crime Harm Index (CCHI) changes in 100 days pre to post treatment, Koper v Pop-Up patrol outcome differences and patrol output analysis.

As discussed earlier the results presented here are over 100 days between June and September 2015. Officers from the NPT's conducted 3776 geo-fenced patrols during this time totalling 538 hours. The comparisons between geo-fenced patrols and officers self-reported patrols are presented in this section and discussed further in the next chapter.

Koper Patrols v Pop-Up Patrols: Street Crime & ASB Calls for Service

The results in figure.4 below show the average number of street crimes and ASB calls for service per day in both control (15 minute) and treatment (5 minute) days. In total there were 62 recorded street crimes and ASB calls for service across this 100 day period. Total recorded street crimes and ASB on 15 minute days (n=32) averaged 0.561 per day (s=0.824) compared to total recorded street crimes and ASB on 5 minute days (n=30) averaging 0.697 per day (s=0.741). This represents, on

average, a 19.51% reduction in street crime and ASB calls for service associated with 15 minute patrol days. Further, Cohen's effect size value (d = 0.175) suggests a small practical significance favouring longer less frequent patrols[14].

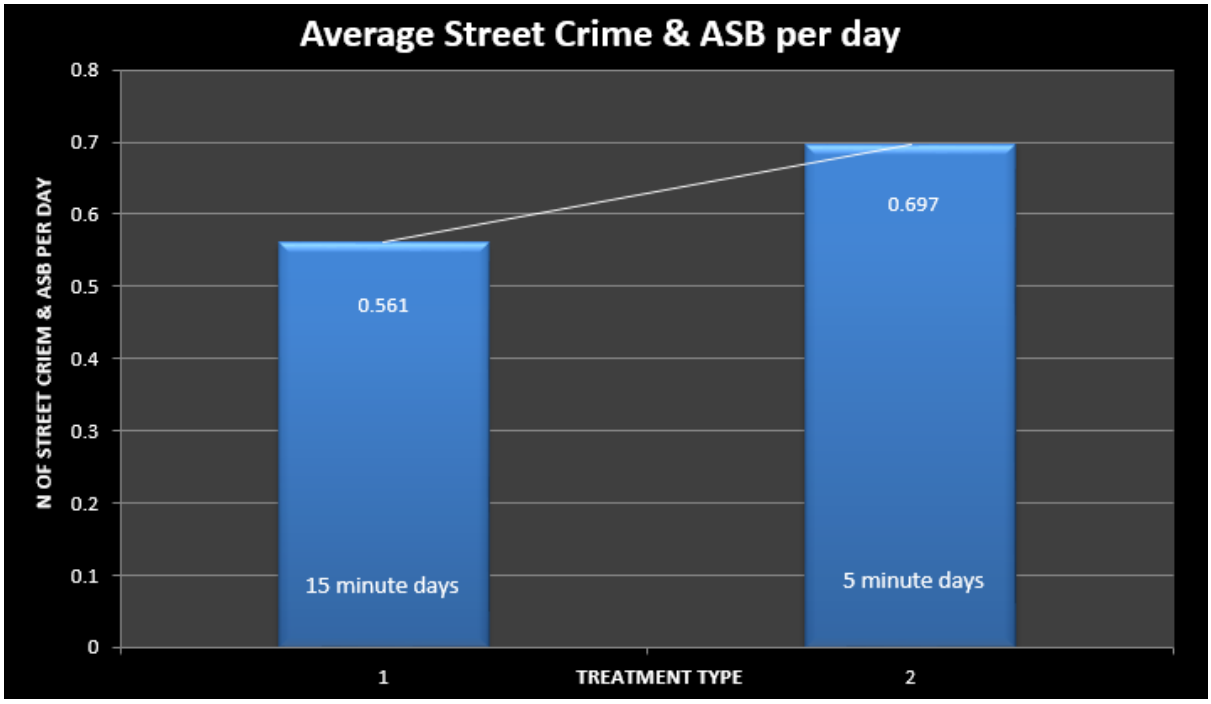


Figure 4: 15 minute v 5 minute Average Street Crime & ASB per Day

Combined Hot Spot Treatment: Street Crime & ASB Calls for Service

In addition to presenting the data relating to the effect of shorter more frequent patrols against longer less frequent patrols figure.5 below shows the combined overall effect of both kinds of hot spot patrol when compared with both

[14]

Full Sample Standard Deviation =	0.783	
	Mean	Number
Treatment	0.698	301
Control	0.561	399
d =	0.1758	
95% C.I. =	0.0258	0.3257
v =	0.0059	

control hot spots and treatment hot spots during the same time period in 2014 and 2013.

As figure.5 shows there were increases in reported street crimes and ASB calls for service per day in both treatment (+12.9%) and control (+14%) hot spots between 2013 and 2014. However, in 2015 control hot spots showed a reduction in street crime and ASB calls for service of 32% down from (n=104) 1.04 incidents per day (s=1.31) to (n=71) 0.71 incidents per day (s=1.322).

Analysis reveals that the average number of street crimes and ASB calls for service during the 2015 treatment period was (n=62) 0.62 per day (s=1.016) compared with control hot spots which saw an average of (n=71) 0.71 street crimes and ASB calls for service per day (s=1.322). This represents an overall reduction in demand at treatment hot spots of 14% compared to control hot spots in 2015.

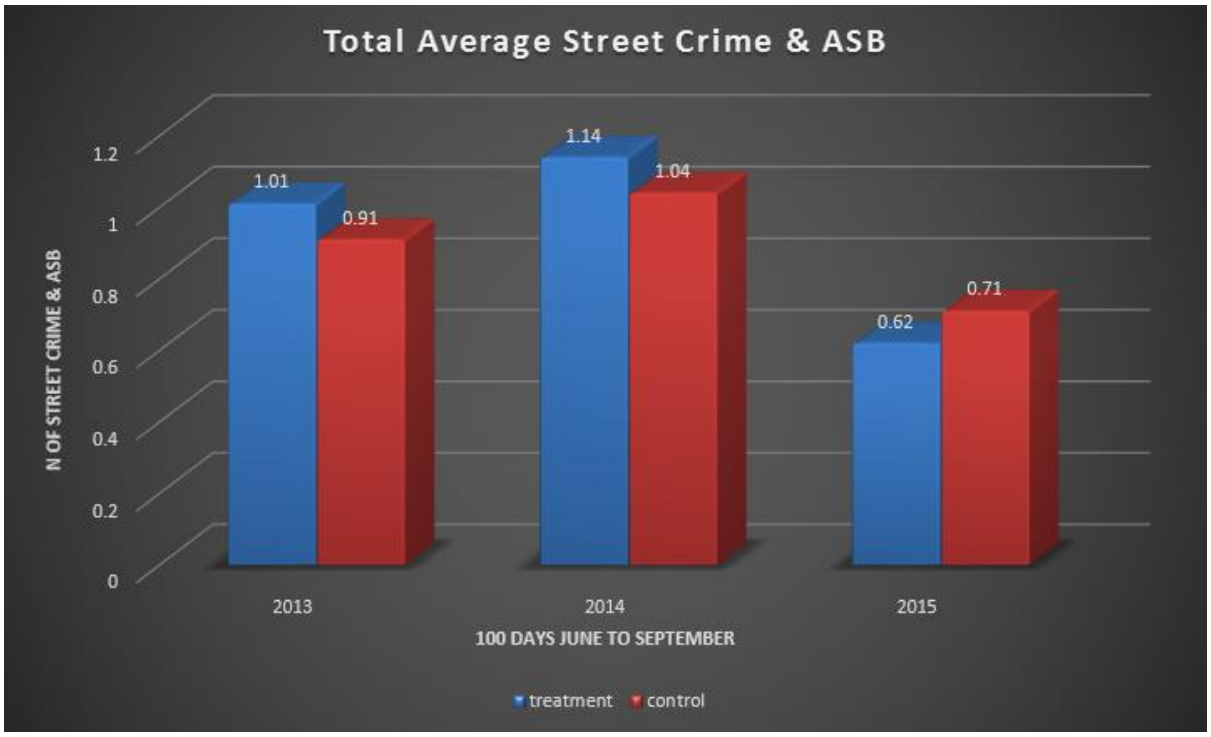


Figure 5: Total Average Street Crime & ASB (2013, 2014 & 2015)

Combined Hot Spot Treatment: Differences in Street Crime & ASB Calls for Service

The greatest reductions were seen in ASB calls for service in both treatment and control hot spots when comparing the same time periods in 2014 and 2015. Treatment hot spots saw a reduction of 36 (-56%) fewer ASB calls for service whilst control hot spots saw 24 (-40%) fewer incidents of ASB. Additional targeted visible patrols in treatment hot spots reduced the number of complaints of ASB by 33% compared with control hot spots.

Street crimes were reduced by 32% in treatment hot spots compared with the same time in 2014 where there was a reduction of 16 fewer victims of crime. Control hot spots also saw a reduction in street crimes but not to the degree of treatment areas; there were 9 fewer victims accounting for a 20% reduction compared to the same time period in 2014. Additional patrols in treatments hot spots reduced victims of crime by 44% compared with control hot spots.

Table 1: Table below shows Street Crime and ASB year on year comparisons

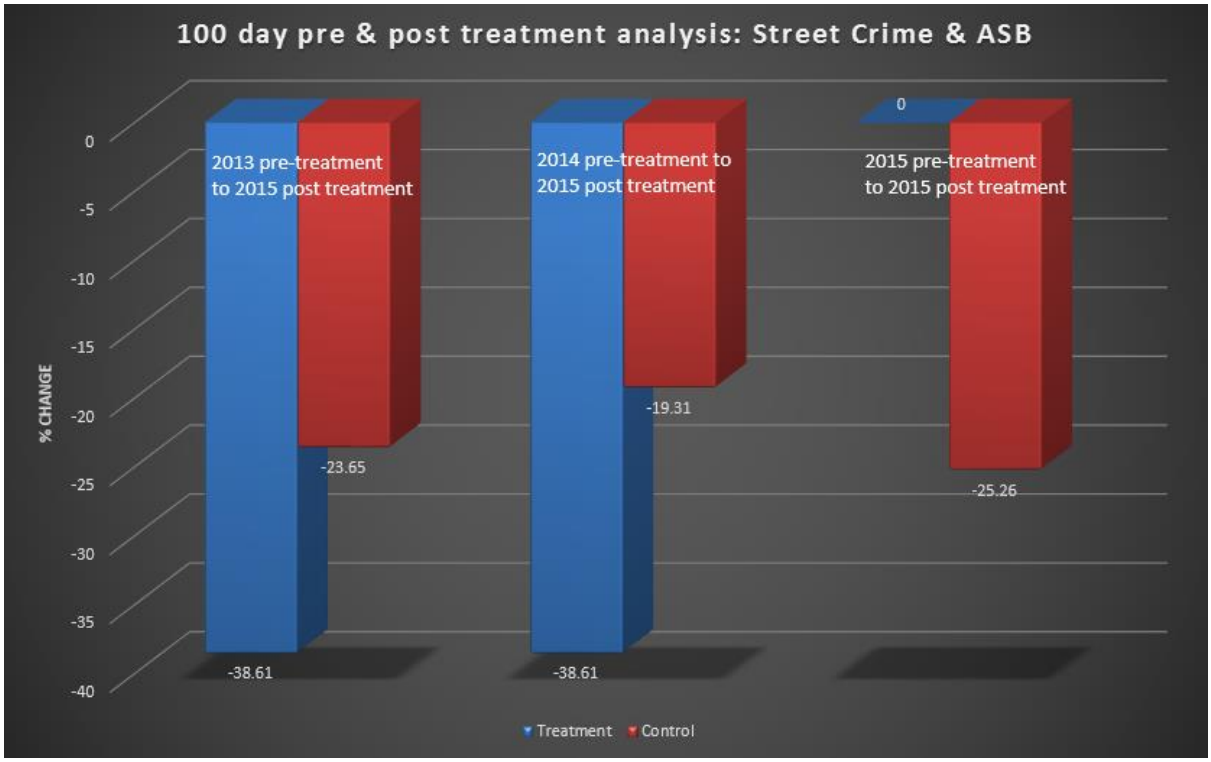
Street Crime Treatment v Control Comparison						
	2013	2014	2015	2013-14	2014-15	2013-15
Treatment (n=7)	Grand Total (n of offences)			Diff & % change		
	42	50	34	8 (+19%)	-16 (-32%)	-8 (-19%)
Controls (n=7)	Grand Total (n of offences)			Diff & % change		
	37	44	35	7 (+19%)	-9 (-20%)	-2 (-5%)
ASB Calls for Service Treatment v Control Comparison						
	2013	2014	2015	2013-14	2014-15	2013-15
Treatment (n=7)	Grand Total (n of offences)			Diff & % change		
	59	64	28	5 (+9%)	-36 (-56%)	-31 (-52%)
Controls (n=7)	Grand Total (n of offences)			Diff & % change		
	54	60	36	6 (+11%)	-24 (-40%)	-18 (-33%)
Overall Street Crime & ASB Calls for Service Treatment v Control Comparison						
	2013	2014	2015	2013-14	2014-15	2013-15
Treatment (n=7)	Grand Total (n of offences)			Diff & % change		
	101	114	62	13 (+13%)	-52 (-46%)	-39 (-39%)
Controls (n=7)	Grand Total (n of offences)			Diff & % change		
	91	104	71	13 (+14%)	-33 (-32%)	-20 (-22%)

Street Crime & ASB Outcomes: 100 day pre to post treatment analysis

The figure below shows the percentage change between the period 100 days prior to treatment beginning and 100 days post treatment. When comparing the 2013 and 2014 pre-treatment periods against the 2015 treatment period there is a stable reduction of 38.61% in demand (39 fewer offences reduced in each time period). There is also a relatively stable reduction in control hot spots, although this is not as

marked as the reduction in treatment hot spots (23.65% 2013 to 2015 and 19.31% 2014 to 2015).

Figure 6: 100 day pre & post treatment analysis



A surprising yet explainable finding here is that there was no difference between street crime and ASB in the 100 days pre-treatment to 100 days post treatment in experimental hot spots. In contrast however, control hot spots saw a further reduction similar to that seen in 2013 and 2014 (25.26%). The zero reduction in demand from street crimes and ASB in treatment hot spots can, in part, be accounted for by the fact that the 100 day period prior to this experiment was saw the introduction of a hot spot methodology across Perry Barr Constituency in 'Phase 1' of this experiment. During this period there was limited tracking of officers and the data from those that were tracked was used to test the 'geo-fencing' spreadsheet. There was no direct feedback of patrol data but an expectation that there would be self-reported patrol updates that reflected 3 x 15 minute patrols in hot spots per day.

Street crimes and ASB calls for service outcomes were tracked for this period and a before after comparison of street crime and ASB calls for service is shown below[15]. The comparison of demand is made against the three other policing areas that form BWC LPU; City Centre (C), Ladywood East (LE) and Ladywood West (LW).

Table 2 below shows combined Street Crimes & ASB calls for service in 'Phase 1' of this experiment

		STREET CRIME				ASB			
		Apr May 2014	Apr / May 2015	Diff	% Change	Apr May 2014	Apr / May 2015	Diff	% Change
CC	Hot Spot 15m patrol	113	187	74	65.5%	235	153	-82	-34.9%
PB	Hot Spot 15m patrol	40	32	-8	-20.0%	52	31	-21	-40.4%
LE	Hot Spot 15m patrol	60	95	35	58.3%	106	57	-49	-46.2%
LW	Hot Spot 15m patrol	62	78	16	25.8%	78	48	-30	-38.5%

This overview of demand data shows that in the two months prior to this experiment beginning Perry Barr (PB) was the only area to be reducing both street

[15] The above data relates to 102 recorded hot spots across the four areas of BW LPU, it includes the experimental hot spots treated as part of this research and compares the time period of April and May 2014 with the same time period in 2015 following the introduction of hot spot policing for two months across Perry Barr.

crime and ASB calls for service. The other three areas of BWC LPU during the same time saw, on average, a 48% rise in street crime during this period compared to a -20% reduction across Perry Barr hot spots. The average reduction across all four areas in ASB calls for service was 40%.

Street Crime & ASB Calls for Service: Diffusion of Benefits Analysis

It was not possible to produce data for this section based directly on the 100 experimental days used for targeted, geo-fenced patrols. However, it was possible to produce a summary of diffusion of benefits for the period when phase 1 of this experiment began on the 1st April 2015 until the 10th September 2015.

In general, rather than dispersing Street Crime, patrols in Hot Spots appear to have a radiating effect of deterrence or diffusion of benefit where reductions seen from 2014 to 2015 in treatment hot spots are also seen in the surrounding areas. However, whether this reduction is directly due to police action or a more general reduction in Street Crime and ASB in the area is more difficult to establish.

During the period in scope for this analysis (1st April 2015 to 10th September 2015) overall there has been a reduction of −149 −46.6% Street Crimes and ASB in treatment hot spots, with a further reduction of −146 −28.7% events in 150m x 150 m grids immediately adjacent to the hot spots. Specifically this has led to a −35.7% reduction in Street Crime (−16.7% TRC) within treatment hot spots and a −23.1% decrease in Street Crime (−8.0% TRC) in the surrounding area. For ASB the percentages were −55.6% within hot spots and −32.8% outside, although it should

be noted that E-Notes[16] has driven a decrease in the recording of ASB which will affect this dataset.

All treatment hot spot mapping of diffusion of benefits is included in the appendix of this paper (Appendix.1).

Crime Harm Index Outcomes: 100 day pre and post treatment analysis

The intention in this section of data analysis was to provide a comparison of Cambridge Crime Harm Index (CCHI) levels both 100 days pre-treatment to post treatment of hot spots alongside a comparison of the same time periods in 2014 and 2013. However, the WMP had to develop the ability to translate raw crime counts data into CCHI levels and the data presented only provides a pre-post comparison at this time[17]. There is however an interesting comparison between those offences

[16] E-notes is a system used by WMP Contact Management Centres as a customer relationship tool whereby all forms of contact with the public are recorded. As a result this may inadvertently hide demand from searchable police systems such as OASIS where an e-note will be created for a non-emergency incident but an OASIS log will not. This system was introduced in November 2013 and up to August 2014 there were over 715,047 e-note records created. I am not aware of any research available within WMP that will clarify exactly how this has impacted on searchable ASB calls for service incidents.

[17] WMP worked with Durham Constabulary who had formulated a spreadsheet to convert raw crime counts into CCHI. This had been adapted and developed by Durham Constabulary where Assault (1 day) and ABH (20 days) had been amalgamated into a single category of Violence against Person (21 days). WMP separated these back into individual categories. Simply adding the sentencing days together to give an overall value for the two combined did not make sense when they have such differing harm values and may skew any results. For example if you had 5 ABH and 10 Assaults in your dataset, using the original Durham Constabulary Version would provide a CHI value of 315 (15 x 21) for ABH and Assault combined as Violence against Person, but the true values based on the WMP amended index are a CHI value of 100 (5 x 20) for ABH and a CHI value of 10 (1 x 10) for Assault. The only categories that could be combined without impacting on the results are those with an identical number of sentencing days. As a result a new category was added a new category to the spreadsheet of GBH with intent (1460 days). This is one of the crime types included by Sherman et al. (2014) and I could see no reason why this should be excluded. We have a number of offences in our two years crime data which fall under GBH.

classified as ‘violent’ and offences classified as ‘serious or acquisitive’ crime. The categories from the CCHI used to produce this analysis are below[18].

Figure.6 below shows that there was a total of 8667 CCHI days post treatment compared with 6946 CCHI days in the 100 pre-treatment days. This represents an increase of 24.77% in crime harm even though the total number of street crime offences was reduced from 35 to 33 offences (a 5.71% decrease in street crime). This was driven by an increase in violence offences carrying a greater degree of crime harm. Three out of seven treatment hot spots shows an increase in

[18]

CRIME_TYPE	Sentencing Days
Rape	1,825
ABH	20
Serious sexual offences (minus rape)	365
Other burglary	20
Dwelling burglary	20
Robbery	365
Homicide	5,475
Theft of vehicle	20
Theft from vehicle	2
Theft from person	20
Arson	33
Criminal damage	2
GBH with Intent	1460
Assault	1
GBH without intent	365

violent crime, two showed no change and one hotspot reduced in violent offending. In comparison control hot spots saw a reduction of 3351 CCHI days which represents a 36.5% reduction in crime harm; again there was also a reduction in recorded street crime down by 12.2% from 41 pre-treatment offences to 36 post treatment offences.

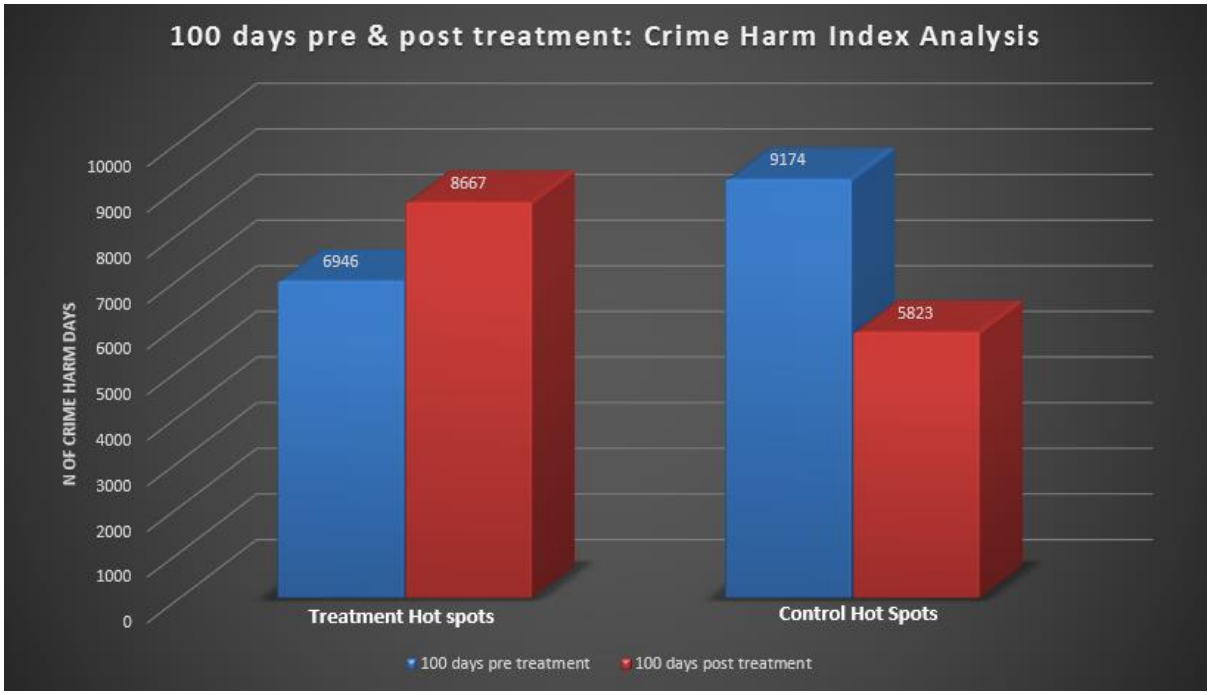


Figure 7: 100 days pre & post treatment CCHI values across treatment and control hotspots

Further analysis of CCHI data from treatment hot spots provides an interesting insight into the potential effect that hot spot patrol may have on street crime, particularly violent crime[19] which is a priority for many forces in England and Wales.

[19] For the purposes of this analysis Violent (VI) crime included; Assault, ABH, GBH with intent, GBH without intent and Homicide. Serious and Acquisitive crimes included; Burglary Other, Burglary Dwelling, Arson, Criminal Damage, Robbery, Theft from and of motor vehicle, Theft from the person and Criminal Damage. SAC

Figures.7 & 8 below show the key differences between violent offences (VI) and serious and acquisitive (SAC) offending within the pre and post treatment hot spots. As we know the period between pre and post treatment saw a reduction in offences (of 5.71%) but an increase in overall crime harm. Pre-treatment analysis between VI and SAC shows that they were split fairly evenly with 18 violent crimes and 17 acquisitive offences which was similar as a percentage of total crime but accounted for 77% of crime harm (total 6946 CCHI days).

In contrast the post treatment analysis shows that recorded VI offences reduced by 60.1% (7 offences compared to 18) whereas recorded SAC offences saw an increase of 52.94% (an increase of 9 offences from 17 to 26). Post treatment VI offending accounted for just 21.21% of total crime which is a reduction of 58.75% compared with pre-treatment analysis. In terms of the percentage of VI crime harm offending, this accounted for 55% post treatment, a reduction of 28.58% compared with pre-treatment VI offending. Post treatment SAC offending accounted for 45% of crime harm (an increase of 95.82% in comparison with pre-treatment).

Even though total crime harm days increased during the post treatment period, granular analysis shows that this was fuelled by four offences; three of these were recorded as GBH with intent and one GBH without intent. A review of these crimes suggests that the three GBH with intent offences were committed in one particular hot spot (BW14, Villa Road, Lozells) which has, in the past, been linked to VI crime. All three were in a public place but behind closed doors; i.e. inside a food outlet or shops.

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offences are those which have historically been targeted by front line uniformed officers in the past, however there is a far greater emphasis on reducing VI crime in the WMP where it is seen as a force priority. Of note the current structure of investigation teams in the WMP means that all SAC offences covered by the Theft Act are investigated by one team of officers and all VI offences are investigated by another set of investigators; arguably some robberies that use force

Figure 8: Violence & SAC, Pre-Treatment Analysis

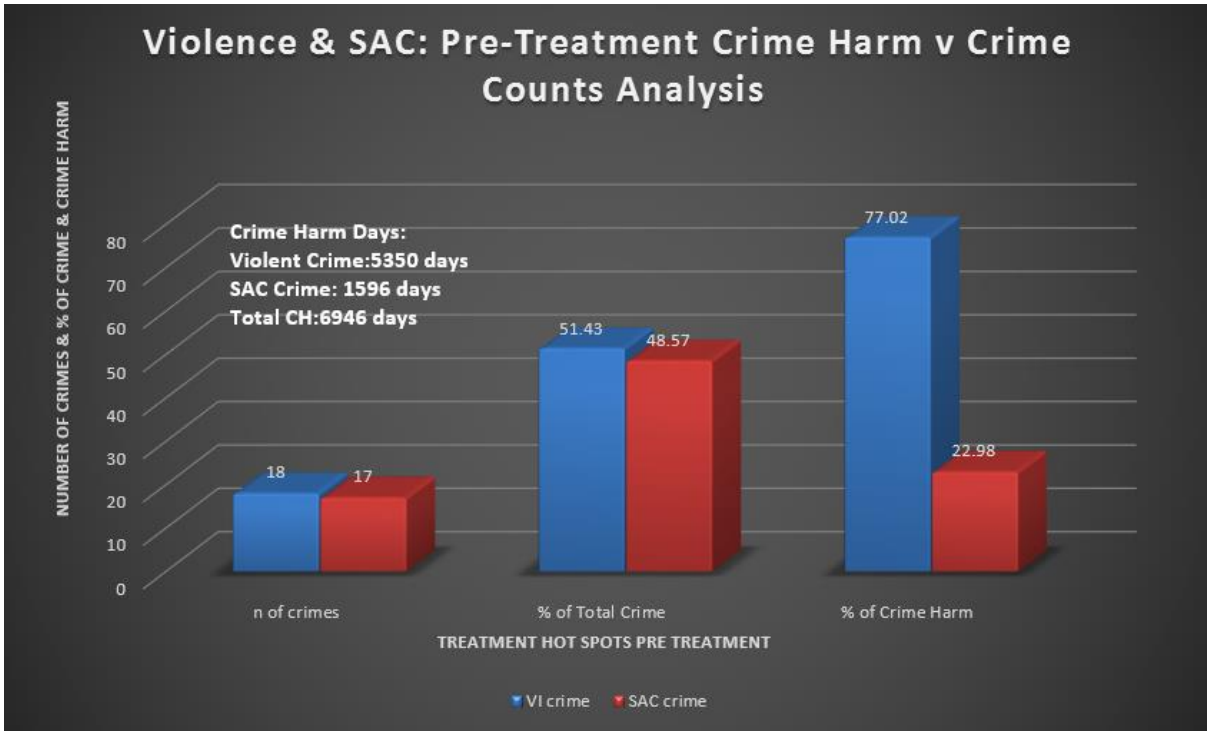
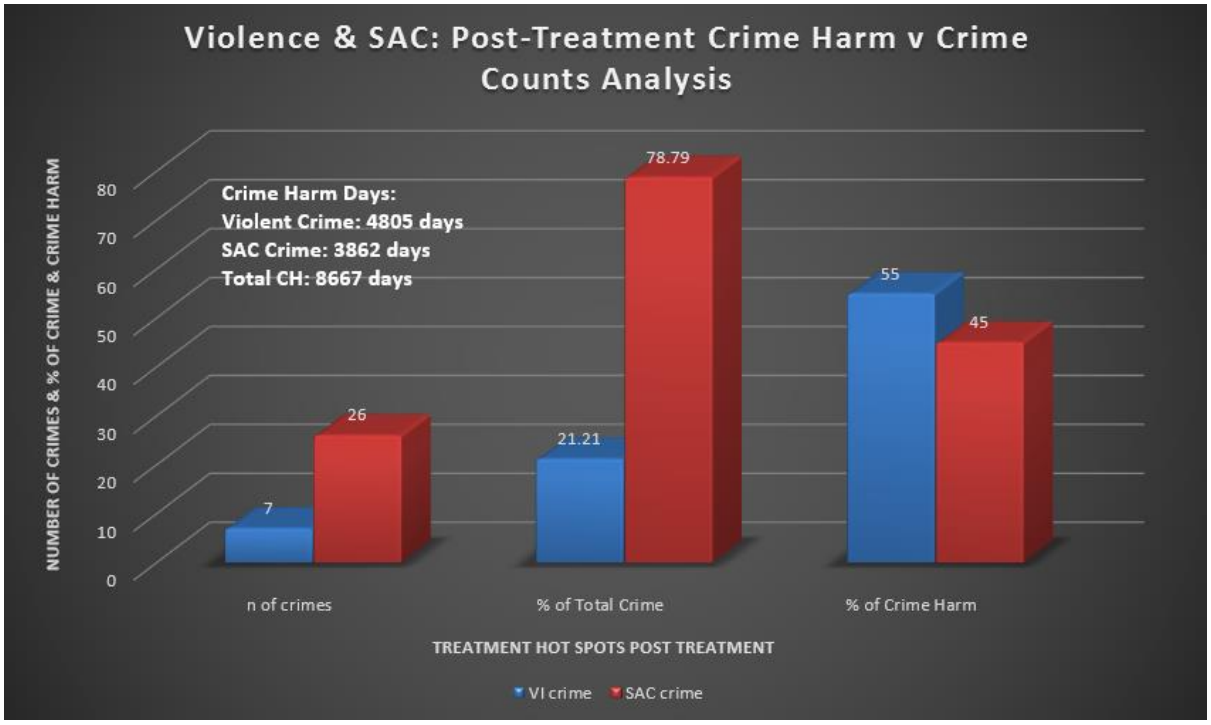


Figure 9: Violence & SAC: Post-Treatment Analysis



Koper Patrols versus Pop-Up Patrols: Patrol Outcomes

The following two tables present GPS 'geo-fenced' patrol and self reported single or double crewing data for patrol days assigned to both 15 and 5 minute patrols. The first table (Table.3) shows patrol data based on geo-fencing alone and does not properly account for officers entering and leaving a hot spot together at the same time. The second table (Table.4 shows patrol data based on both geo-fenced patrols and officers self reported single or double crewing.

Table 3: Key differences in 5 and 15 minute patrols days (Geo-fenced data only)

Based on Geo-fencing Data Alone			Key Differences
	5 (43days)	15 (57 days)	
Target Time on Patrol	225:45:00	299:15:00	
Total Time on Patrol	199:40:00	285:14:00	88% v 95% patrol compliance
Av time on patrol per day	04:38:36 (s=0.10)	05:00:15 (s=0.10)	22 mins difference per day
Total N of Patrols	2056	1720	336 more 5 min patrols
Average N of Patrols per day	47.813 (s=22.76)	30.175 (s=22.38)	76% compliance with 5 min visits v +42% overdose of 15 min visits
Average daily time per HS	00:39:42	00:42:51	3 mins difference per HS
Average Time per patrol	00:05 (s=3.24)	00:09:42 (s=3.22)	00:04:42 minutes more patrol time

Table 4: Key differences in 5 and 15 minute days (Geo-fenced data and self-reported single/double crewing).

Based on Single & Double Crewing Plus Geo-fencing Data			Key Differences
	5 (43days)	15 (57 days)	
Target Time on Patrol	225:45:00	299:15:00	
Total Time on Patrol	108:00:00	159:20:00	48% v 53% patrol time compliance
Av time on patrol per day	03:00:00	02:49:08	11 minutes less time on average per 15 min day
Total N of Patrols	1543	956	587 more 5 minute patrols
Average N of Patrols per day	36 (s=16.98)	17 (s=16.73)	57% of 5 min v 81% of 15 min
Average daily time per HS	00:25:42	00:24:16	00:01:26 minutes difference per day
Average Time per patrol	00:05	00:09:42	00:04:42 minutes more patrol time

Total Time on Patrol: Overall Dosage

As discussed earlier, the ability to actually use geo-fencing technology within this experiment was in doubt, because WMP does not have the software to automatically report patrol time or frequency. However, those driving this experiment were able to design a spreadsheet capable of handling big data (This experiment generated in excess of 200,000 email ‘pings’ that were analysed).

Based on geo-fencing data alone officers spent in excess of 484 hours on patrol across both Koper and Pop-Up patrol types; 199 hours, 40 minutes on 5 minute patrols compared with 285 hours and 14 minutes on 15 mintue patrols (over the 100 day experiment 43 days were randomly allocated to 5 mintue patrols; 57 to 15 minute patrols).

The target time for officers to have been on patrol across 100 days was 524 hours; 225 hours and 45 minutes for 5 minute days and 299 hours 15 minutes for 15

minute days. This means that officers compliance across 15 minute patrol days was 95% in comparison with a compliance level of 88% for 5 minute patrol days.

However, when we look at geo-fencing data again by adding in adjustments for single and double crewing of officers patrolling hot spots we see a different compliance story altogether. The compliance rates reduce from 95% to 81% for 15 minute patrol days and from 88% to 57% for 5 minute patrol days. One of the biggest hurdles overcome in implementing this experiment was challenging a culture where there had been some but very little accountability for patrol delivery (that was recorded in any great detail). Initially it was clear that officers did not want to engage with shorter more frequent patrols; annecdotaly they beloeved they were spending more time travelling between hot spots that than they were actually patrolling. In summary this data supports patrolling for longer less frequently to gain maximum complinace of overall time spent at hotspots.

Average Time on Patrol: Daily Dosage

On examining the average time officers spent on patrol each day using both geo-fenced only and with added self reported single and double crewing data both 5 minute and 15 minute days are very closely matched. The average time on patrol across all hot spots per day for geo-fenced only data was 4 hours and 38 minutes for 5 minute patrols compared with 5 hours for 15 minute patrols. This is a difference of 22 minutes of overall dosage across 7 hot spots. When we add the self reported single and double crewing data this gap reduced from 22 minutes to 11 minutes; avaerage time on patrol per day during 5 minute patrols was 3 hours compared with 2 hours 49 minutes during 15 minute patrols. Both raw geo-fencing and additional

officer crewing data shows that both patrol types have a similar total daily dosage of visible patrol across hotspots.

In addition to the finding above when we look at the average daily time officers spent in each individual hot spot this mirrors both overal time spent and daily dosage. Officers spent an average of 39 minutes and 42 seconds on patrol during 5 minute patrol days in each hot spot compared with an average of 42 minutes 51 seconds during 15 minute patrol days. This is based soley on geo-fencing data. When we add officers self reported single and double crewing data this becomes an average of 25 minutes 42 seconds for 5 minute patrol days and 24 minutes 16 seconds for 15 minute days. Both data sets show a very small difference of 3 minutes (geo-fenced only) and 1 minute 26 seconds (geo-fenced and self reported).

For clarity officers were tasked with patrolling each hot spot for 45 minutes per day; conducting nine 5 minute patrols or three 15 minute patrols as randomly allocated. Consistently across 100 days officers did not provide the exact amount of time required. Figure.9 shows each experimental day set out with the daily dosage received, this shows that dosage was inconsistently delivered but also shows that the integrity of treatment of days as assigned was high. The objective at the beginning of this experiment was to obtain 150 days data; 75 days of each type of patrol. However, as already disucssed this became impossible due to the loss of geo-fencing capability. Even though we were limited to 106 days of data to examine only 6 were removed, 4 due to geo-femcing failure and 2 as they were not treated as assigned meaning that 98% of days were treated as randinly allocated.

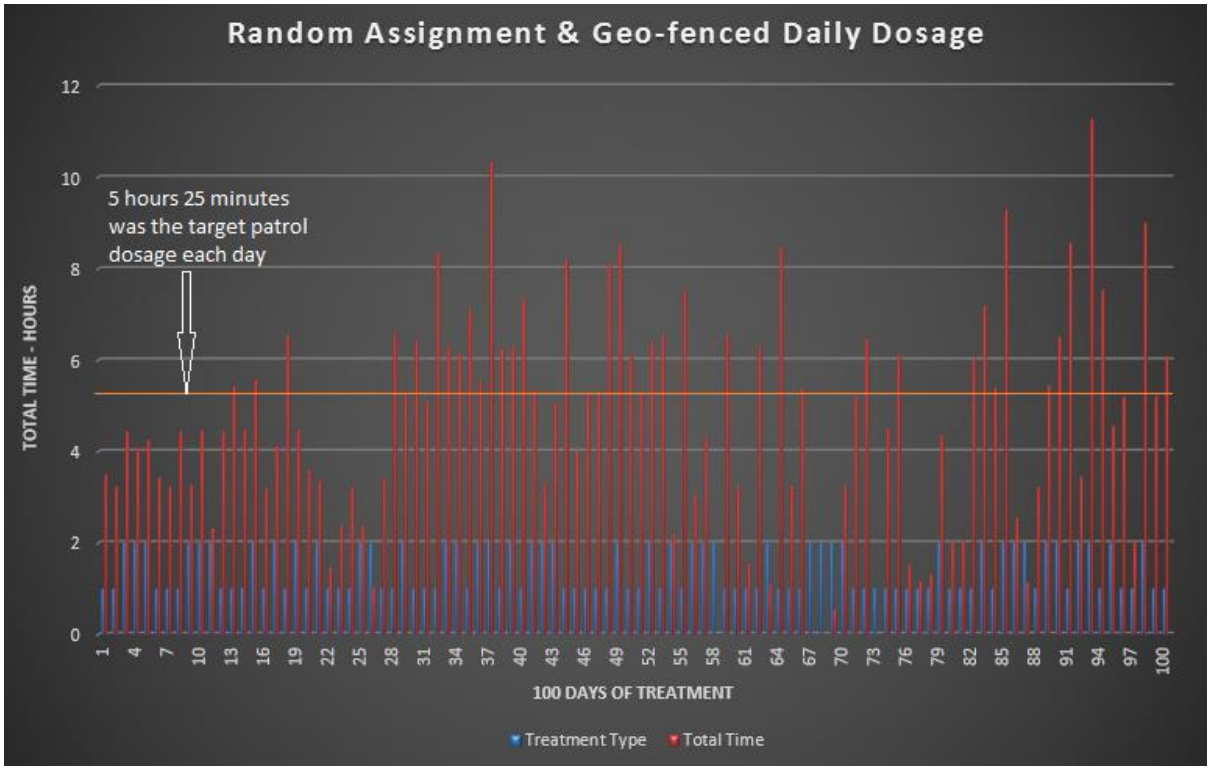


Figure 10: shows geo-fenced only dosage against patrol type 1 or 2 in blue (1 being 15 minute days and 2 being 5 minute days)

The final data to present that relates to days treated as assigned is the average time spent on each patrol. Although there were over 200,000 individual geo-fenced email 'pings' gathered during the experiment we isolated 7812 of these for our 100 day period providing a total of 3906 individually geo-fenced officer patrols.

During these patrols officers spent an average of exacty 5 minutes during 5 minute patrol days and an average of 9 minutes 42 seconds during 15 minute patrol days. This begins to explain why overall dosage is so similar in terms of daily hours and minutes spent per hot spot even though the percentage compliance of 15 minute patrols was significantly greater.

Activity Analysis: What is it that Cops actually do whilst on Hot Spots Patrol?

Officers returned 2208 activity reports across the 100 days analysed throughout this results section. This represents a 94% response rate against the number of single and double crewed patrol reports for the same period. An example of the activity report can be found in the appendix of this paper (Appendix.2).

Table.5 below provides full data on each category of patrol activity, including whether the patrol was single or double crewed and what mode of patrol was used; either foot or bicycle. Over 50 percent of patrols in both 5 and 15 minute patrol days were double crewed and the vast majority (over 97 percent in both patrol types) of patrols were conducted on foot as opposed to on a bicycle.

Although not captured in the activity analysis one of the reasons for this high percentage of foot patrol was the use of a police vehicle to travel between hot spots, particularly during 5 minute patrol days where officers direct feedback to first and second line supervisors made it clear that they felt they spent too much time travelling between hot spots rather than actually patrolling them.

Table 5: Patrol outputs and their % of total patrols of 15 and 5 minute patrol days

Activity Analysis: 15 min v 5 min patrol days					
Activity	15 min patrol returns (N and % of patrols)		5 min patrol returns (n and % of patrols)		Difference +/- %
foot patrol single	297	34.7	614	45.34	+10.6
foot patrol double	544	63.7	723	53.39	-10.6
bike patrol single	3	0.36	1	0.07	-0.29
bike patrol double	10	1.19	16	1.18	+0.01
om visit/contact	0	0	0	0	0
deal with pedestrian	56	6.55	33	2.43	-4.19
stop search pedestrian	2	0.23	1	0.07	-0.17
deal motorist	26	3.04	24	1.77	-1.29
stop search motorist	0	0	0	0	0
Arrest	3	0.35	2	0.14	-0.21
deal response log	36	4.21	40	2.95	-1.29
deal incident in view	20	2.34	13	0.96	-1.42
intel gathering	63	7.37	33	2.43	-5.02
community engagement	329	38.52	332	24.51	-14.29
visit top 3 demand location	196	22.95	166	12.25	-10.89
visit top 3 asb location	228	26.69	277	20.45	-6.39

The key differences in patrol outputs between 5 and 15 minute patrols are visually presented in figure.10 below. Grouping together low frequency outputs; offender management contacts, dealing with pedestrians and motorists, stop and searches, arrests, dealing with response logs, incidents in view and intelligence accounted for only 10.75% of outputs on 5 minute patrol days. In comparison this same group of outputs accounts for more than double (24.09%) during 15 minute patrol days.

The analysis shows that the most frequent patrol outputs on both 5 and 15 minute days were community engagement, visits to demand crime micro-locations and visits to demand ASB micro-locations. This is not surprising given that officers

were instructed, as part of their hot spots briefings, to pay visits to businesses or public places where repeat calls for service were generated.

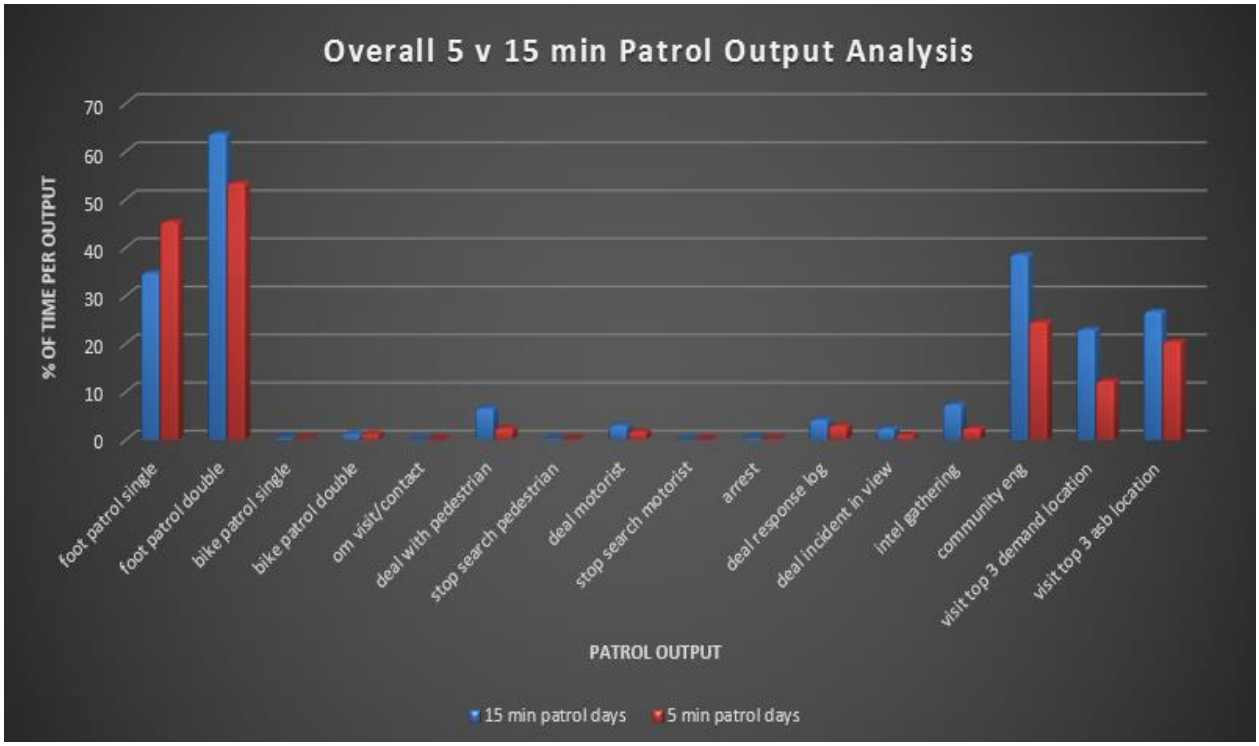


Figure 11: shows the frequency of patrol outputs during 2208 separate patrols of 5 and 15 minutes.

However, there is a notable difference between the community engagement and visits to micro-locations categories when comparing 5 and 15 minutes. During 5 minute patrols, where officers spend less time but visit hot spots more frequently, community engagement and visits to crime and ASB micro-locations accounted for 57.21% of patrol outputs. Whereas 88.16% of patrol outputs during 15 minute patrols were accounted for by this group. This is not an unexpected finding given that 5 minutes is a very short time to patrol a 150m x 150m hot spot grid.

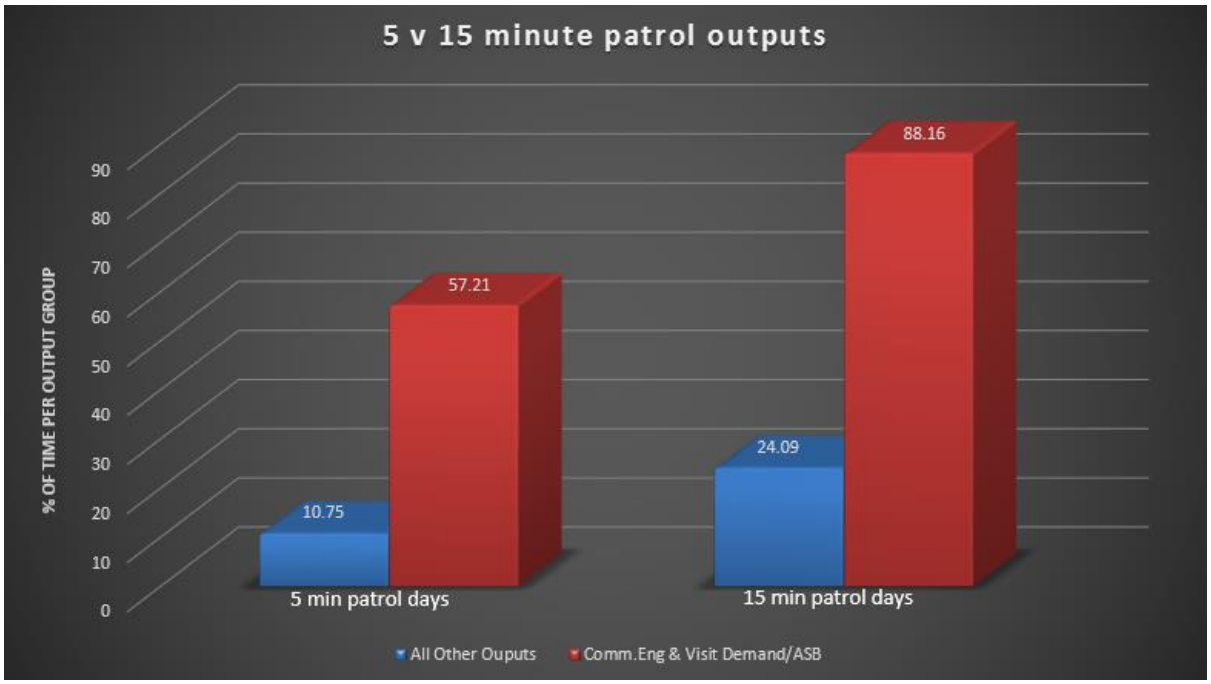


Figure 12: shows differences between low frequency and high frequency patrol outputs on 5 and 15 minute patrol days

The low frequency group of outputs are similar to interactions described by Erving Goffman (1961) where focused interactions are classified as people effectively sustaining for a time single focus of cognitive and visual attention; i.e. stop and searches, dealing with pedestrians or motorists or arrests. Goffman describes the opposite interactions as unfocused consisting of inter-personal communications resulting solely by virtue of persons being in one another's presence; i.e. visible patrol, community engagement and short visits to micro-locations of crime and ASB within a hotspot.

Discussion

Theoretical Implications

During this experiment Koper's 1995 finding where 15 minutes was the optimal time to spend on patrol has been robustly tested against shorter more frequent patrols. This is the first time that an experiment in hot spots policing has been conducted in this manner using a design that sees treatment hot spots acting as their own controls over the course of 700 individual patrol cases. Koper's finding that 10 minutes of patrol time is a tipping point in achieving greater deterrence appears to have survived contact with this experiment with results supporting this 20 year old finding.

Weisburd and Britt (2007) state that statistical power is an important consideration in any research experiment. When it comes to hot spots policing experiments this is particularly true. Take the Sacramento study as an example (Telep, et al. 2012) where 42 hot spots were pair matched and treatment conducted over a 90 day period; this provided the ability of this study to detect a large effect size of .80. This experiment used 7 hot spots to compare two different ways of delivering patrol dosage producing a small but notable effect size (d=0.17) favouring longer less frequent patrols. In addition to this the 7 treatment hot spots were compared with 7 control hot spots to provide data for the overall effect on street crimes and ASB calls for service where greater reductions in demand were seen in treatment areas. Again the data from this experiment supports a hot spot methodology of targeting place to reduce demand.

In relation to Sherman's (2014) strategy for 'Causing the Causes of Crime Reduction' this study supports the need for a formal feedback approach. Whilst this experiment did not isolate and test this feedback to officers I can say with certainty that hot spot patrols taking place in control areas did not have the degree of scrutiny against them that treatment hot spots received. Likewise both control and treatment areas in 2013 and 2014 were not subject to directed patrol of this nature. The methodology of targeted patrols using the Koper curve (Koper, 1995) was not part of business as usual at this time.

Policy Implications

The current WMP ethical demand management policy should, based on this and other evidence from hot spots studies in the UK, be re-drafted to include the major areas that contribute to causing the causes of crime reduction. Specifically; tracking of officers, feeding back patrol data to first and second line supervisors and, most importantly to those conducting patrols and finally providing the infrastructure in IT terms to bound officers' decision making. WMP are not geared up to use GPS tracking on a wider scale for all types of patrol and investment is required to replicate this study and make hot spots policing business as usual.

Although WMP are in a period where officers are becoming more accountable for their outputs there is very little support for first and second line supervisors to monitor compliance of their staff. Sherman (2013) states that 'for all the progress that COMPSTAT has brought to policing, it is striking how little measurement it has used of what police do.' How can we expect our managers to be effective if they do not have the tools to review exactly where their cops have been? There is also a counter

argument to the advancement in technology which could lead to an information overload or ‘the clutter problem’ (Gladwell, 2000). The consideration of any new technology being developed is to enable the ‘Stickiness Factor’ (Gladwell, 2000) to take hold and allow the message of where, when and how to patrol a hot spot to get through.

Compliance was a key measure of this study, it is clear that it is far more achievable to cause officers to patrol for longer and less frequently. On Koper treatment days officers were given a clear instruction to patrol each hot spot for 15 minutes along with a map of each hot spot, they failed to comply with this evidence based direction and actually patrolled for 10 minutes. WMP is now working with its business change partner to incorporate the results from this study into an IT based support solution that guides and prompts officers tasked with hot spots patrols. The days of Sergeants and Inspectors relying on self-reported patrol feedback must surely be numbered.

Overall is would appear that there is very little in the way of traditional police enforcement activity taking place during hot spots patrols. It is clear from this evidence that the main activities that lead to hot spot patrols reducing demand are visibility, community engagement and visits to both crime and ASB micro-locations within hot spots grids. To conduct these patrol activities there is no requirement for patrolling officers to have police powers, on the contrary, it would appear that this evidence supports findings from previous studies (Ariel, 2015 & Sherman & Ariel, 2014) that non-warranted officers are not only capable of reducing demand but the most appropriate choice of resource for this tactic.

A consideration for the WMP during the next 4 years will be in deciding how or even if it continues with hot spots policing as a tactic that is used everywhere. The staffing challenges of meeting the required budget cuts, even in the wake of the Autumn 2015 Comprehensive Spending Review post the terrorist incidents in Paris, still mean that staffing levels will reduce. The questions for WMP senior leaders to ask themselves are two fold; firstly do we have enough staff to meet demand external to hot spots patrols and secondly if we do conduct hot spot patrols where are they best conducted to maximise cost benefit.

With the WMP set to lose over 80% of its Police Community Support Officers within the next 12-18 months serious consideration ought to be given that those remaining PCSO's (approx.119 officers) are used to not only increase our currency in community engagement and relationships with the public but should be given responsibility for delivering targeted hot spot patrols into those hot spots that produce the greatest levels of demand for WMP; i.e. the city centre of Birmingham.

An issue that this study failed to take account of prior to beginning phase 2 in June 2015 was in calculating the total demand that hot spots across Perry Barr and the wider LPU accounted for. In fact, the hot spots treated across Perry Barr only account for 5% of the whole areas total demand, even when the surrounding 150m x 150m grids are added (taking into account diffusion of benefits) this only rises to approximately 20%. Take for example the city centre of Birmingham where hot spots account for over 80% of total demand, if results from this experiment could be replicated using the same methodology then the benefits have the potential to be far greater in terms of reduced victims of crime and victims of crime harm.

In contrast to other small hot spots studies (Goddard, 2013) that used only a small number of officers to conduct directed hot spots patrols this study took place across a larger area where all constables and PCSO's were expected to contribute towards the required number of patrols. A total of 52 officers were available across the teams that cover Perry Barr with the vast majority taking an interest in the experiment. Prior to the experiment beginning in earnest there was a responsive, ever changing patrol culture present where officers would move from one crime pattern to the next based on local priorities or tasking from members of the community. In the space of 6 months, since the beginning of phase 1, there is now a culture of hot spot patrolling embedded across Perry Barr as a sector. This could only have been brought about by considering and putting into place those key elements from Sherman's (2014) strategy of hot spots policing.

Limitations of this study

The biggest challenge in making this experiment happen was in adapting current WMP IT software in order to track and analyse geo-fenced data produced by officers patrolling treatment hot spots.

There were two main issues; firstly that the 'Geo-fencing' spreadsheet could not differentiate between single and double crewed patrols relying instead on the use of officer self-reported crewing data to produce additional patrol analysis. This hampers to a degree the accuracy of actual single and double crewed patrol data available, however, did have a benefit in officers tasked with patrols becoming engaged with the process.

Secondly that the control hot spots were not geo-fenced so an accurate estimate of patrol dosage and frequency of patrols cannot be reported as a baseline against which treatment hot spots can be compared. This issue, in the main part, was a consequence of having only a small number of resources allocated to the back office function of this experiment. Those involved were maintaining this research alongside existing internal demand and also did not have the access to manage some of the IT software directly.

Conclusions

This experiment has shown that it is possible to implement and track in detail a hot spots strategy capable of reducing demand across a busy metropolitan policing area in a relatively short time period whilst, at the same time, experimenting with two very different types of patrol delivery. This research should now act as a catalyst for WMP, or indeed any other interested agency, in targeting hot spot locations of crime and driving a wedge of culture change through existing patrol activities.

There are a number of main key findings from this study that will pose further questions to leaders across WMP;

1) Koper's (1995) threshold of 10 minutes patrol time producing greater deterrence returns is supported when directly compared to shorter (5 minute) more frequent patrols. In this study they were associated with a further 20% reduction in Street Crime and ASB.

2) Shorter more frequent patrols of 5 minutes duration do lead to a reduction in demand; however, the reality of causing these patrols to occur is challenging resulting in less compliance.

3) Crime Harm associated with violent crime is reduced by hot spots patrols when compared to the period of time directly before patrols were implemented (by 60.1%) saving 545 sentencing days.

4) Officers conducting patrols and supervisors managing patrols should be supported by IT software for added accountability, feedback and engagement in the process. Officers routinely reported conducting 15 minute patrols yet on average for these patrols only conducted 10 minutes patrol within a hot spot.

5) Patrol outputs low in frequency are those associated with the use of more intrusive police powers such as stop and search or arrest. High frequency patrol outputs (on average over 72% of all patrols) were associated with visibility and engagement requiring no specific police powers.

6) That the body of evidence reporting positive reductions relating to hot spots patrol is supported by this study; Street Crime and ASB were reduced by 46% in 2015 compared with the same time in 2014.

These overview findings from this study lead me to recommend that following a re-drafted demand reduction policy, leaning on this and other studies, a phased roll out of 15 minute tracked Koper patrols across key demand sectors within WMP be implemented in 2016.

Simon Williams (Police Sergeant 5062)

West Midlands Police

December 2015.

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Appendices

Appendix 1: Diffusion of Benefits Street Crime and ASB Mapping

BW1 - Austin Road / Holyhead Road

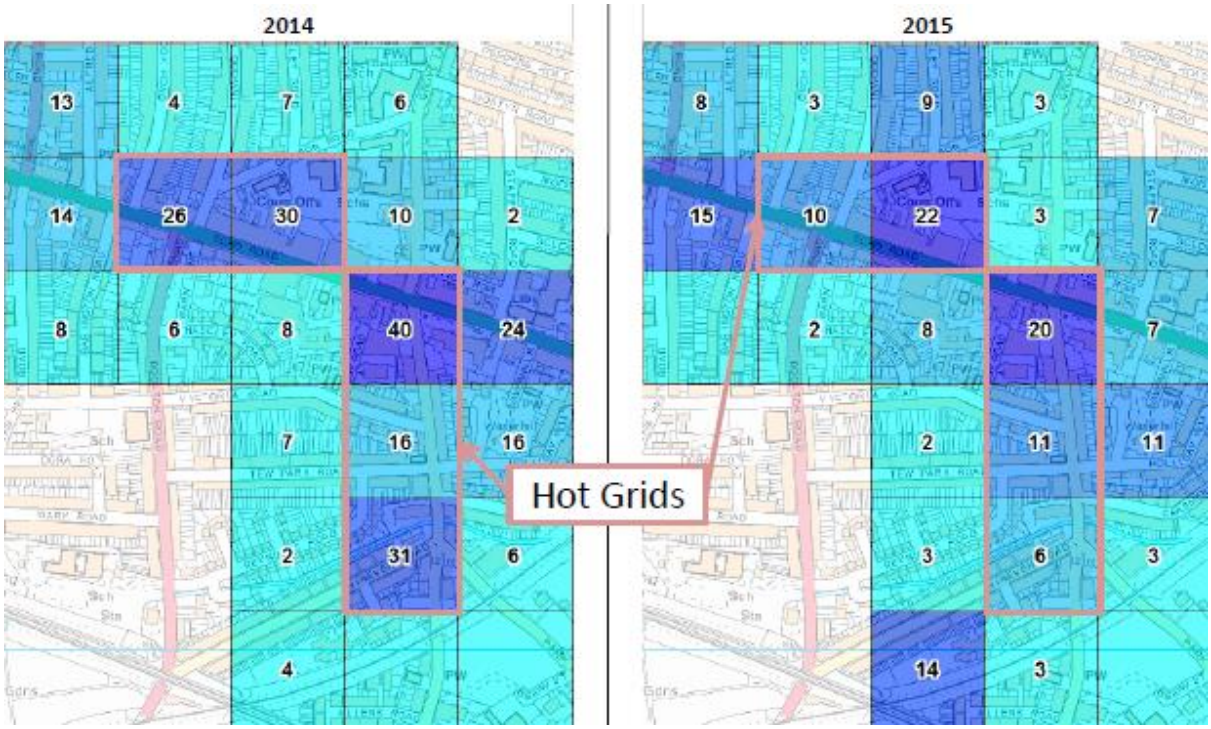
The two maps below show levels of Street Crime and ASB committed between 1st April to 10th September in 2014 and 2015. 2014 is included as a comparison to show levels of Street Crime and ASB before patrols started and is included in all subsequent data.

Measuring the outer grids

•2014 average: 9.00 events per grid (95% confidence interval (7.48, 10.52) based on $t7$ distribution)

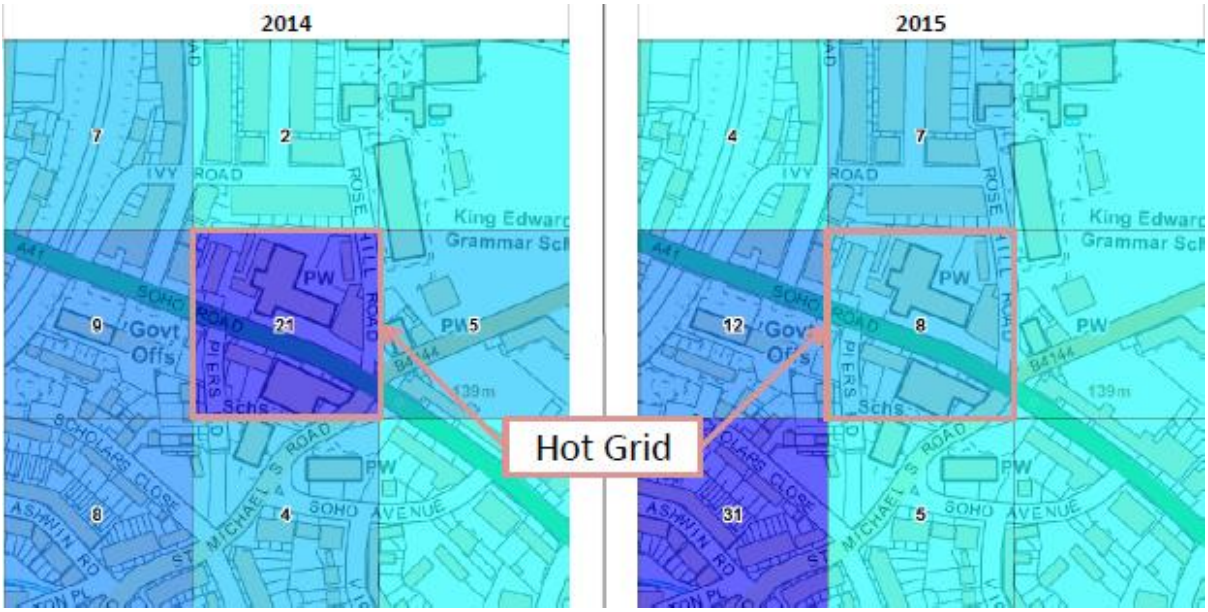
•2015 average: 4.75 events per grid (95% confidence interval (3.69, 5.81) based on $t7$ distribution)

BW5 - Soho Road / Bacchus Road



Measuring the outer grids
•2014 average: 7.67 events per grid (95% confidence interval (6.93, 8.41) based on $t17$ distribution)
•2015 average: 5.61 events per grid (95% confidence interval (5.05, 6.17) based on $t17$ distribution)

BW10 - Soho Road / Villa Road

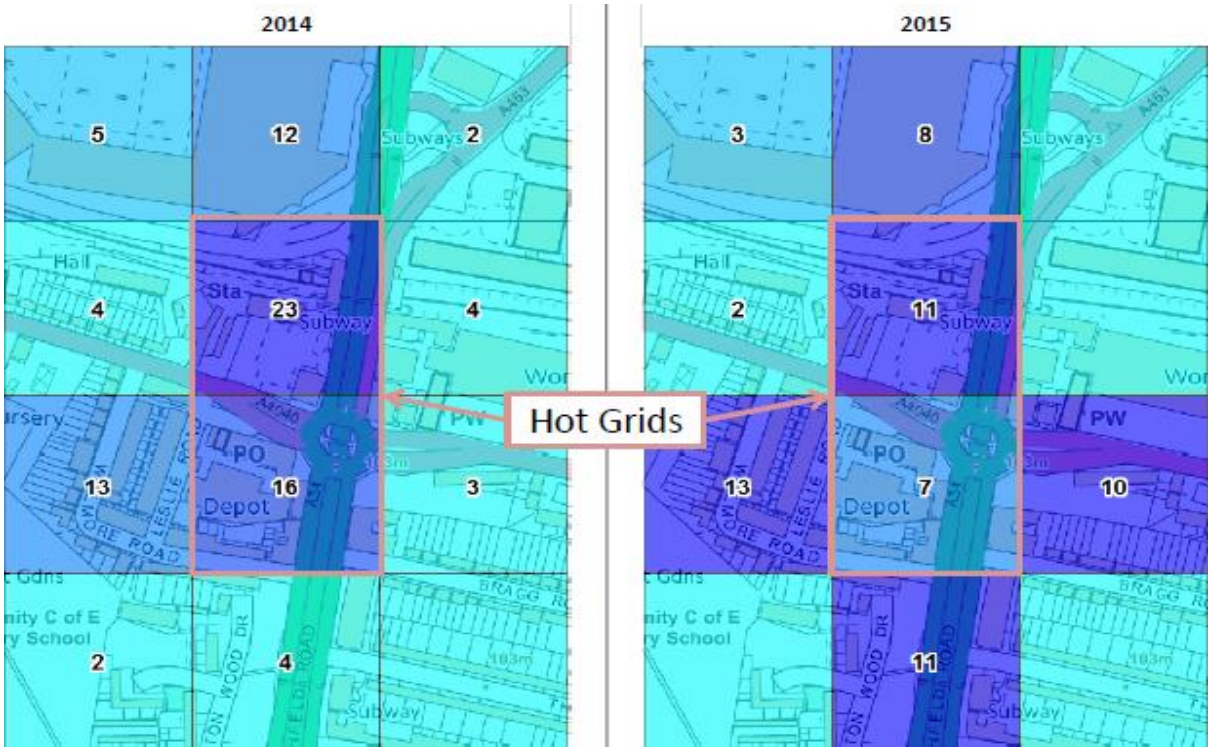


•2014 average: 4.38 events per grid (95% confidence interval (3.19, 5.56) based on $t7$ distribution)
•2015 average: 7.50 events per grid (95% confidence interval (4.01, 10.99) based on $t7$ distribution)

BW14 - Villa Road / Hamstead Road

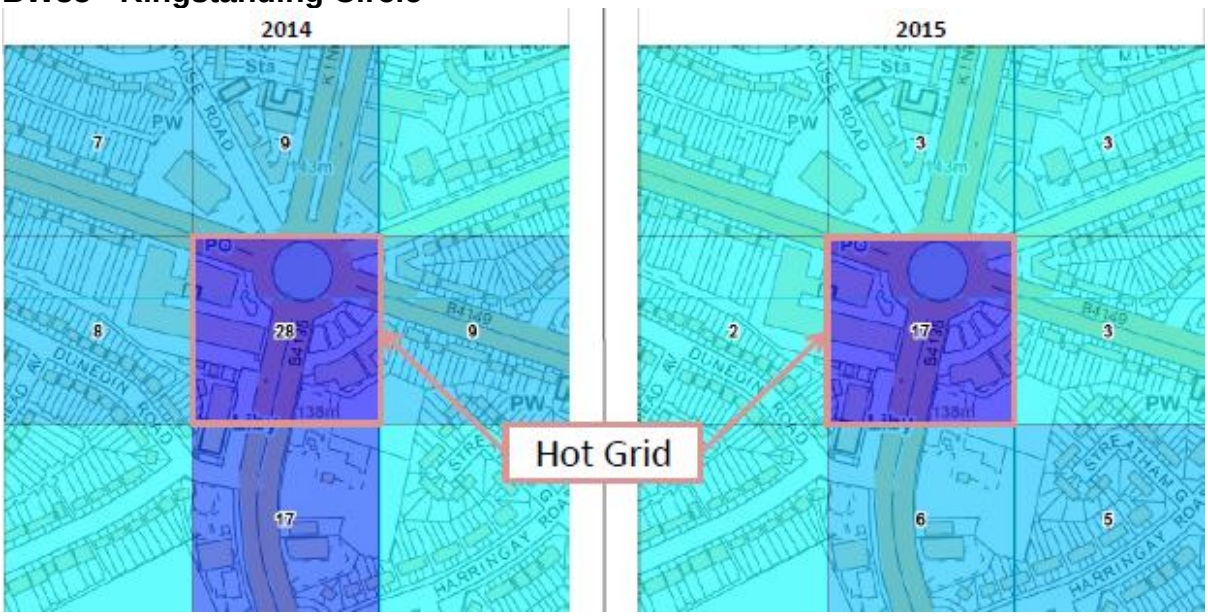
•2014 average: 12.00 events per grid (95% confidence interval (10.01, 13.99) based on $t7$ distribution)
•2015 average: 8.13 events per grid (95% confidence interval (6.99, 9.26) based on $t7$ distribution)

BW35 & 36 - Birchfield Road



•2014 average: 5.00 events per grid (95% confidence interval (3.96, 6.04) based on $t9$ distribution)
•Hot Grid 19.5 events (significantly higher)
•2015 average: 4.70 events per grid (95% confidence interval (3.39, 6.01) based on $t9$ distribution)

BW85 - Kingstanding Circle



•2014 average: 6.63 events per grid (95% confidence interval (4.75, 8.50) based on $t7$ distribution)
•2015 average: 3.00 events per grid (95% confidence interval (2.40, 3.60) based on $t7$ distribution)

Appendix.2: Example of Activity Sheet for data collection

Perry Barr Constituency Targeted Area Patrol Activity Analysis

Please complete and return to Perry Barr Police Station ASAP after completing patrol.

Name of Officer(s) conducting patrol:

Date of Patrol:

For each TAP patrol conducted please complete this sheet (i.e. for 3 x 15 minute patrols there should be 3 sheets completed, for 9 x 5 minute patrols there should be 9 sheets completed).

Please tick the box where appropriate and where asked add 'Y' and/or further detail.

Activity	**Austin Rd BW1**	**Soho & Dawson BW5**	**Soho & Rose Hill BW10**	**Villa & Hamstead BW14**	**Birchfield Rd BW35**	**Birchfield Rd BW36**	**King Standing Circle BW85**
Time of Patrol (In & Out)							

Foot Patrol Single Crewed							
Foot Patrol Double Crewed							
Bike Patrol Single Crewed							
Bike Patrol Double Crewed							
Offender Management Visit or Contact							
Dealing with Pedestrian (If Stop & Search Conducted add 'Y')							
Dealing with Motorist (If Stop & Search Conducted add 'Y')							
Arrest							
Visit of Demand Crime location							
Visit of Demand ASB caller or location							
Directed to deal with response log							
Dealing with incident in progress in view during patrol							
Developing or gathering Intelligence							
Activity	**Austin Rd BW1**	**Soho & Dawson BW5**	**Soho & Rose Hill BW10**	**Villa & Hamstead BW14**	**Birchfield Rd BW35**	**Birchfield Rd BW36**	**King Standing Circle BW85**
Community Engagement/Reassurance (i.e. face to face contact with community members, NHW, etc.)							
Travel Time between TAP areas & route taken (please list roads)							

Other Activity Not Listed (Please provide clear detail)							

WHY is it important that these activity sheets are completed?

Perry Barr Constituency has been chosen to refine the way we conduct demand reduction or 'TAP' patrols so we know **what works best** to reduce crime and asb for our communities.

ASK yourself this; what have YOU done to improve this 'hotspot' area of crime and asb during your patrol?

A visit to a demand location or conversation with a repeat victim of asb can make a difference to the way in which the community feel about their area.

RECOGNISE the impact YOU have every time you conduct patrol or speak to a member of the public.

If the patrol areas on Perry Barr Constituency were on your families' door step how you would expect the local police to patrol? We are using the latest evidence of 'what works' in patrol with the goal of finding the best way of conducting 'TAP' patrols and identifying what activities are important in reducing crime and asb.

REMEMBER that we are here to serve the community and protect them from harm.

Between March and June 'TAP' areas across BWC have seen a **20% reduction in crime** and a **40% reduction in ASB**!

THANKYOU for the work you all do in reducing crime and asb across Perry Barr 'TAP' areas.