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Charlotte de Brito

Fitzwilliam College

Supervisor: Dr. Barak Ariel

Will Providing Tracking Feedback on Hot Spot Patrols Affect the Amount of Patrol Dosage Delivered?

A Level 4 Experiment

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Abstract

Objectives Hot spots patrol is a police tactic shown time and time again to reduce crime, with a robust body of supporting evidence suggested. Less widely researched is how to ensure the police tasked with carrying out these patrols do as they have been asked. In this thesis, research will be presented which seeks to bridge this gap.

Methods In a before-after experiment carried out over 4 weeks in August 2016 within British Transport Police (BTP), two sites assigned to treatment conditions (London Waterloo and London Euston) were provided feedback on dosage delivery – i.e., weekly reports showing the number of "hot spots visits" carried out the previous week by the PCs and PCSOs assigned to hot spot patrol. Two sites assigned to control conditions received no such information, but were still required to conduct hot spots patrols as business as usual.

Results No overall statistically significant differences in terms of patrol dosage between the two treatment and two control sites were found, indicating that feedback in the form of a set of figures and graphs on the previous weeks' performance sent via email does not increase dosage. However, when the 2 treatment sites were analysed separately, substantial increases were found in patrol dosage at London Waterloo but no discernible effect at London Euston, compared to control conditions. These subgroup analyses are likely to be driven by varying leadership styles in the two treatment sites.

Conclusions Patrol dosage feedback can be positively correlated with patrol dosage, however only when the leader responsible for those individuals is willing to act. In this experiment, there was no adverse consequence for poor patrol performance in the treatment sites, hence the threat can be deemed 'toothless'. Onus cannot be left on individuals to react to and improve on poor performance, and a feedback loop must be put in place to allow corrective action to be taken if an individual consistently fails to improve. Further research is recommended, testing treatment conditions which include an adverse consequence of poor performance, with a larger number of experimental sites.

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Chapter One: Introduction

Crime concentrates in specific locations (Sherman *et al*., 1989; Sherman, 1995; Sherman, 2007), and specifically in very small places, such as street addresses, city blocks and small pieces of land (Weisburd, 2015). These locations have been termed "hot spots" (Sherman *et al.,* 1989). There are profound practical meanings to these concentrations, particularly in terms of crime policies. For instance, increased uniformed officer presence in hot spots of crime and disorder has been suggested to have a modest yet significant effect in reducing crime (Sherman, 2013, Braga *et al.*, 2012). Moreover, visits of 15 minutes have been shown to be optimal patrol duration for maximum residual deterrence (Koper, 2015; Telep *et al.*, 2012; Ariel *et al.*, 2016; Ariel and Sherman, 2012). Each of these claims has been widely studied in experiments with high internal and external validities.

Less researched is how to ensure that Police Constables (PCs) and Police Community Support Officers (PCSOs) tasked with providing uniformed presence in the hot spots actually do what they are supposed to be doing. Rapid advancements in tracking technology have meant it is a reality in most police forces that officer whereabouts can be tracked at all times (Wain and Ariel, 2014), however there is little evidence to show how best to utilise this data to maximise the effect of hot spot patrols.

Evidence Based Policing (EBP) is based upon the three central concepts of '*Targeting, Testing and Tracking*', otherwise known as the 'triple-T' model (Sherman, 2013). When applied to hot spot policing, uniformed resources should be *targeted* to where they will have the most effect in deterring crime, in this case crime hot spots. This theory has been *tested* through experimentation and suggested to work with evidence of crime being reduced. It is important to *track* to ensure the resources remain targeted towards the locations in which they are supposed to be, in order to have the best effect. However, how can raw tracking data be translated into something meaningful which those tasked with carrying out patrols will understand and make use

of in order to improve performance? Sherman *et al* (2014, p. 3) said that '*criminologists are usually more interested in crime than in organizational behaviou*r'. The case very much remains that a large number of questions asking how tracking can affect officer behaviour are still unanswered (Wain and Ariel, 2014). It is not known how to best use tracking data to produce the most successful outcomes possible. When such a large number of police forces claim to be using hot spot policing as their method of patrol, these questions cannot continue to remain unanswered.

British Transport Police (BTP) has a uniform officer headcount of nearly 2,000 PCs and just over 350 PCSOs. A large proportion of these resources are tasked on a daily basis with carrying out preventative hot spot patrol visits in hot spots of crime all over BTP's jurisdiction. BTP analysts identify long-term hot spot locations, based on 3 years of crime data, and create 'Patrol Cards' to be used by BTP's patrolling workforce. Each patrolling PC or PCSO, on a daily basis, is tasked with a patrol card by their supervisor, showing them the hot spots they have a responsibility to visit, and the times during which they are due to make these patrols. Thus far, no data has been available on the number of hot spot visits carried out by this vast patrolling workforce, in order to identify areas of non-compliance and make changes where necessary to ensure individuals are at the right place, at the right time.

This research bridges that gap within the literature and within British Transport Police's daily deployment practices. It seeks to carry out an experiment with one key, overarching question: '*Will Providing Tracking Feedback on Hot Spot Patrols Affect the Amount of Patrol Dosage Delivered?*' Four experimental sites were selected from within the BTP jurisdiction, and two assigned to treatment, two to control. All sites were tasked to patrol the hot spots; for a period of one week in all four sites, all continued to patrol the hot spots as normal, in order to establish a baseline, except that the data on the patrol card returned to the central team was recorded and coded. Then, in the second week (hereinafter known as 'Week 1'), the supervisors

at two of the treatment locations received a feedback report consisting of their patrol data from the previous week. This procedure was carried out over the course of three weeks.

As part of the analysis, the treatment and control locations were compared and statistical tests were carried out to establish whether any differences between the groups, in terms of dosage, were statistically significant. Next, the individual sites were analysed separately in a sub group analysis, in order to address any variations between the sites. A brief piece of analysis not initially intended to take place as part of this research will then be carried out to use as an indicator of how hot spot patrol is being managed day to day in BTP. The data collected for this research was the first time data on hot spot patrol has been available in BTP, and therefore analysis on daily deployment by supervisors is a worthwhile inclusion, as recommendations will be made for improvement. Finally, analysis was conducted to determine whether any effect was detected between patrol visits and crime outcomes.

It should be made clear from the outset that the analysis is limited, as is the statistical power of the test. The short running time of the experiment, the small number of sites involved, and the limited amount of data which were logged, are – collectively – insufficient for solid conclusions. Instead, the findings are suggestive and can serve as the foundation for a more elaborate and powerful test of feedback.

The final three chapters of this thesis will be an extended discussion of the results, followed by recommendations for policy and further research considerations, and a summary of the conclusions. First however, the available literature will be reviewed, which identifies the gaps that this research aims to fill.

Chapter Two: Literature Review

Evidence Based Policing (EBP) at its simplest can be described as establishing '*what works*' when it comes to policing activities (Sherman, 2013), and is based upon three central themes, known as the 'three Ts' – Targeting, Tracking and Testing (Sherman, 2013). In order to provide the best possible policing service and reduce the harm caused to the public to the greatest extent, policing tactics should be *targeted* to where they will have the most impact; activities should be *tracked* to ensure they are being carried out as required and the impact remains significant; and perhaps most importantly, activities should be *tested* to ensure the best possible tactic is chosen for the particular situation and not just the method which is the status quo. The EBP movement is developing rapidly, and a matrix of tested initiatives has been formed and is updated as new tests are carried out (Lum *et al*., 2011). This matrix allows police organisations to quickly and easily establish whether a test has been carried out on a particular practice, and allows readers to ascertain the rigour of the experimental methods applied before decisions are made to implement it.

One particular stream within EBP that has gained incredible momentum is hot spots policing. The evidence base and literature available on hot spots policing and its effect on reducing crime is perhaps the largest of any one policing tactic (Braga *et al.*, 2012). Less widely researched is the day to day operational management of patrols, particularly in the non-experimental conditions required to maintain momentum and keep dosage to the hot spots high in the business as usual environment especially when other pressures are competing for resources. How can consistent delivery be maintained? How can the officers tasked with carrying out the patrols be imparted with the motivation to continue doing their job day in day out? Is there a mechanism through which local managers can implement a consistent harm-reducing, evidence based intervention? The current situation in criminological research is that very little is known. Repeating the quote previously used, as summarised quite elegantly by Sherman *et al*

(2014, p. 3), '*criminologists are usually more interested in crime than in organisational behaviour*'. Other than broad guidelines (for example Fixsen *et al*., 2005), the answers to these questions are simply yet to be discovered, so much so that Wain and Ariel ended their comprehensive summary of the current use of tracking in police by concluding that there remain a number of questions on '*how tracking technology can affect officer behaviour*' (Wain and Ariel, 2014, p. 8).

This literature review will therefore be broken down into three sections, starting with a brief summary of hot spot patrol literature in experimental criminology for the purpose of providing a background to the subject, and reviewing the developing focus on quantifying and reducing the harm caused by crime as opposed to simply reducing crime volumes. These sections will be followed by a review of the theories behind why hot spot policing works, namely deterrence theory. Literature on how tracking data is used to influence patrols and what effect it has on individuals will be discussed, and finally, a more in depth review of literature focused specifically on the tracking of patrols in practice will be carried out. As will be shown, the literature is rather thin on both the former and latter subjects. General management literature on why increased tracking of patrols may have a correlational relationship with volume of patrols carried out will also be summarised. These sections together will form a comprehensive and targeted summary of past theoretical and empirical literature and will clearly demonstrate the gap which the research questions posed in this thesis seek to fill.

Hot Spots Patrol

Crime Concentrations

Crime concentrates (Sherman *et al*., 1989; Sherman, 1995; Sherman, 2007; Weisburd, 2015). In his 2007 work, Sherman described the concept now widely known as the power few (Sherman, 2007), where a small percentage of units in any distribution of crime account for the greatest proportion of crime. Just as where a small percentage of victims will be continuously re-victimised and account for a significant proportion of total crime, for example where 2 per cent of the UK

population experience 41 per cent of property crime (Pease, 2008), a power few locations will account for a significant proportion of overall crime. This phenomenon was first documented in Minneapolis (USA) where only 3 per cent of street addresses generated over half of all police calls for rapid response (Sherman *et al*., 1989). These locations were initially termed 'hot spots', defined most succinctly on the micro level as '*small places in which the occurrence of crime is so frequent that it is highly predictable, at least over a one year period' (*Sherman *et al.,* 1989*).* More recent literature concentrates on individual addresses, clusters of addresses and street segments (Sherman, 2013), however the latest studies show that the phenomenon can also be applied to locations with transient populations such as tube stations (Ariel and Sherman, 2012) and bus stops (Ariel and Partridge, 2016).

Harm versus Count Concentrations

However*, 'all crimes are not created equal*' (Sherman *et al*., 2014). The concept of measuring harm as opposed to counting crimes when identifying hot spots is one which has been gaining momentum. Crimes which result in an injury to the victim or even a death cause considerably more harm than 'less serious' crimes such as shoplifting or possession of a small amount of drugs. Classifying a murder and a shop theft as of equal importance when analysing crime statistics and using the resulting analysis to influence proactive police deployment should be crimes in themselves! What is a much more effective way of identifying and targeting hot spots is to weight crimes by the harm which they cause (Sherman *et al*., 2014). The method proposed and most commonly accepted to carry this out is by using the recommended number of days an offender would be sent to prison for when carrying out a first offence, taken from the sentencing guidelines. This will justifiably skew hot spots identification towards those where the most significantly harmful crimes have been carried out and allow more effective prioritisation of resources towards these locations.

Targeting Hot Spots

Deploying uniformed police resource to these hot spots reduces crime in those hot spots (Sherman, 2013), and evidence suggests this tactic may also reduce crime in the surrounding area as well as in the hot spot itself (Ariel *et al*., 2016). The first full hot spot patrol Randomised Controlled Trial (RCT) carried out in Minneapolis (Sherman and Weisburd, 1995) showed that by doubling the time spent in high crime hot spots at hot times by marked police cars, crime and disorder in those hot spots is measurably reduced. The findings have been replicated many times since and the evidence base suggesting hot spots policing works is unparalleled in criminology. A Systematic Review showed that 20 out of 25 tests of hot spots policing reported noteworthy crime decreases, and the accompanying meta-analysis of outcome measures highlighted a small but statistically significant mean effect size favouring hot spot policing in reducing calls for service (also sometimes referred to as 'incidents') in treatment areas versus control locations (Braga *et al*., 2012). Interestingly, when diffusion of crime reduction effects and displacement of crime were measured, crime prevention benefits were associated with the area surrounding the actual hot spot as opposed to an increase in crime through displacement (Braga *et al*., 2012; Rosenfeld *et al*., 2014; Ariel *et al*., 2016).

Why does this reduction in crime occur in hot spots which have had uniformed police presence? There are many theories which seek to answer this question. Felson and Cohen (1979) outlined a 'routine activity' approach, whereby for a crime to occur, convergence in time and space of a likely offender, a suitable target and the absence of a capable guardian were required. Deterrence theory looks at why crimes may be prevented through the threat of adverse consequences, specifically the certainty of being apprehended by the aforementioned capable guardian (Bottoms and von Hirsch 2012). Ariel *et al* (2016) showed that a 'capable guardian' does not even require 'hard' police powers to be effective, as unarmed PCSOs with no power of arrest were found to be causally linked to lower counts in crime as well as lower crime harm (Ariel *et al*., 2016). Koper (1995) showed that the optimal patrol duration for an officer in a hot spot for

maximum residual deterrence was 15 minutes, a theory tested in a randomised experiment in Sacramento (USA), which showed significant overall reductions in both crimes and calls for service in treatment hot spots when compared to control (Telep *et al*., 2012), and also in Peterborough (UK), where 15 minute patrols were shown to have significant declines in crimes and calls for service in treatment areas relative to control (Ariel *et al*., 2016). Furthermore, in British Transport Police itself, where 15 minute patrols by uniformed police officers, four times a day over the course of an eight hour late shift, four days a week, for six consecutive months were shown to reduce crime 24/7 by 14 per cent in treatment areas compared to control (Ariel and Sherman, 2012).

This, however, is not the end of the story. It has been shown that *targeting* high concentrations of crime in particular places with enhanced visible policing presence reduces crime and calls for service, and that this principle has been thoroughly *tested* and suggested to work. But what about *tracking*? How can tracking be used to influence outcomes? A culture still persists whereby an officer on patrol still has a large amount of discretion to patrol when and where they see fit, with little feedback from managers to correct non- compliance to directed patrols if any are in place, or without any praise for good patrolling performance. Does this need to change, and what benefit could it have to police organisations which choose to do so? These questions will be answered in the following section.

Using Tracking Outputs to Change Behaviour and Influence Outcomes

In this section, it will be discussed how hot spot tracking data is used in practice to feedback performance to patrollers, which in theory should be plentiful considering a vast number of police forces assert they are carrying out hot spot patrol. It will be summarised how feedback could be used by police managers and the situations and formats it can be used in. Finally, the effect feedback has on individual officers' behaviour, and the theory behind why changes might occur when tracking data is used as a management tool will be explored, along with whether there is

anything in general management theory literature which supports the criminology theory that tracking will increase compliance to patrols.

In their 2014 paper, Sherman *et al* state that an essential requirement for success when implementing a hot spot patrol model within any force is that *'feeding back is essential to scaling up*'. Sherman *et al*., (2015) created a Station Level Cop-Stat for Police Commanders explaining how best to use tracking data to feedback, with the aim of increasing police patrols and consequently reducing crime. The use of transformational leadership is highlighted as advantageous, as it is not fear of punishment but pride of achievement which will persuade officers to carry out the greatest volume of patrols possible. They indicate that using tracking feedback hand in hand with information on the positive crime reducing outcomes their patrol work is achieving would have the largest effect when inspiring individuals to patrol. This is echoed in Kotter's 8 step change model, in particular by developing a vision and strategy for change and generating short term wins which are rewarded as a reinforcing mechanism for the change (Kotter, 2012).

It is highlighted that in any change initiative, there are some individuals who either will not or cannot change; these individuals must sadly be removed from the organisation once all has been done to attempt to facilitate the required change (Izatt- White and Saunders, 2014). This can be applied to the management of hot spot patrol – an individual who consistently refuses to change and deliver the required dosage of preventative patrol must be managed appropriately and removed from the police force if necessary. Kotter and Schlesinger (2008, cited by Izatt-White and Saunders, 2014) review six strategies for dealing with resistance to change. Coercion is listed as the final strategy to be used, only as a last resort if all else has failed, supporting the theory that at the very least to begin with, praise should be used to motivate individuals to correct their own poor performance rather than punishment from the outset. Communication is listed as an important strategy, which adds weight to the concept of a CompStat or Cop-Stat (Sherman *et al*., 2014) where the actual patrolling officers are included in a feedback meeting.

Kahneman discusses feedback in his 2011 work and again emphasises that using feedback in a positive way will have more success. He highlights that rewards for improved performance work better than punishment of mistakes (Kahneman, 2011). Taking this important point into consideration, what evidence is there of using tracking feedback to motivate by praising good performance rather than castigate non- adherence to patrol plans? The answer to this question is that the literature is seriously lacking in this respect, as most cases of feedback being used is to highlight non- compliance to patrols and hence punish and correct this behaviour. Ariel (2012) tested the effects of feedback on the tax reporting behaviour of 4,395 organisations in Israel through the dissemination of tax letters to two treatment groups, one group receiving a deterrence message, the other one of moral persuasion. Neither treatment conditions were found to cause significantly greater compliance when compared to control conditions, and more interestingly, it was postulated that if threats were 'toothless', namely that there was no indication that the warning would ever be actualised, taxpayers would be quick to assume the threat was not real and ignore the directive and hence carrying out the threat to begin with was a futile exercise.

In terms of policing, Wain and Ariel (2014) discuss two conflicting constructs when it comes to the effect of feedback of tracking: '*surveillance and accountability*'. Tracking data can be used to ensure individuals have to justify the duration of time they have spent on patrol and the locations in which they have chosen to spend their working hours, thus making them more accountable for actions which were not previously captured. Increased accountability can be linked to an increase in individuals patrolling where directed (Weisburd *et al*., 2012b), however it can come at a price; surveillance of patrol actions through tracking can be seen by the individuals being monitored as micro management, undermining their professional know- how and resulting in a potential erosion of motivation (Wain and Ariel, 2014). Furthermore, tracking performance of UK police using long lists of nationwide indicators has been shown to create a pressure which could lead to perverse behaviour in bending the rules to meet targets, with individuals going

beyond accepted means to achieve them (Parkinson, 2012). This leads to the questions of what evidence exists on tracking within hot spot policing, and whether there is any evidence of its effect on the police officers tasked with carrying out the patrols.

The Tracking of Hot Spots Patrol

The history of hot spot patrol and of feedback in quite generalised terms has been discussed in the previous two sections. What remains to be reviewed is specifically how police patrols were tracked in the experiments previously discussed. What, if anything, was done to increase dosage in these particular experiments? What were the effects of these interventions – did they reduce crime as expected?

Tracking within the Triple- T EBP model can be defined simplistically as '*making sure what works is done – right*' (Sherman, 2016, p. 19). If an intervention has been tested and shown to be successful in reducing crime, and resources are being targeted to carry out this intervention, it is essential to monitor that the dosage is being maintained and the intervention continues to produce the desired outcomes. Within the context of hot spot policing, it is of utmost importance to be able to know with absolute certainty that resources deployed to known crime hot spots are actually delivering the number of minutes or number of visits required to deter crime.

This more precise and cost efficient deployment of resources focused towards prevention and deterrence rather than reactive, knee jerk deployments has meant technology has had to move rapidly to cope with the increased demand for police data to inform decision making. Relatively recent advancements in Global Positioning System (GPS) and the introduction of Airwave radios and patrol cars are bringing policing ever more closer to the ideal situation where the location of every officer on duty can be tracked in real time to within a few meters and it can be ascertained with absolute certainty whether or not they are where they are supposed to be. In his 2013 essay, Sherman highlights that few agencies '*track the key question under discussion: **where** are the police doing **what***?' (Sherman, 2013, p. 38). Wain and Ariel (2014) wrote a

comprehensive summary of the tracking of police patrol to the present day and concluded that '*most police leaders worldwide are not in a position to answer these questions, despite technological advancements*' (Wain and Ariel, 2014, p. 2). CompStat (Bratton, 2011) was introduced with the intention of providing police leaders with the capability to track police patrol; it has been widely used for tracking crime and has led to great reductions in serious crime (Sherman *et al*., 2014, Weisburd and Lum, 2005), but more often than not has served as a tool to target the managers not sufficiently reducing crime (Wain and Ariel, 2014). There have, however, been some isolated examples of tracking police patrol in the experimental criminology literature, which will be summarised in the following sections.

The first hot spot Randomised Controlled Trial, the Minneapolis Experiment (Sherman and Weisburd, 1995) struggled with treatment fidelity after the initial 7 months of the experiment. A combination of summer weather, higher crime and fewer police meant that the dosage difference between treatment and control was not strong enough to observe any reduction in crime. How was this tracked? Self reported patrol logs, as well as independent observations by a team of university researchers were used to monitor the duration of police presence in each spot. Dosage was encouraged by providing patrol supervisors with weekly reports of the data submitted by officers from their patrol logs, as well as a monthly report of dosage as observed by the independent researchers. No information is included in the paper accompanying this experiment on whether this encouragement was successful.

For the Philadelphia (USA) Foot Patrol experiment (Ratcliffe *et al*., 2011), where it was shown that foot patrol reduced violent crime in 60 of Philadelphia's violent crime hot spots, there was no automated tracking, nor even a comprehensive manual tracking alternative (Ratcliffe *et al*., 2011). Graduate students spent 4 hours a day in each of the 60 hot spots observing officer patrols; however the information generated was insufficient to allow extrapolation to show total patrol time for the duration of the experiment. The researchers list this as a limitation of the study, as this issue raises the question of whether a causal relationship between foot patrol in hot

spots and reduction in violent crime actually exists, if it is not certain that the foot patrol actually took place as planned in the first place.

In British Transport Police's own hot spot patrol experiment, Operation Beck (Ariel and Sherman, 2012), 57 of the London Underground's 115 highest crime platforms received 15 minute patrols by uniformed police officers, four times a day during a late turn 3PM - 10PM shift, four days a week (Wednesday to Saturday), for six consecutive months. Officers were manually tracked by having to call in via Airwave radio to a team of dedicated Sergeants, who noted down 23,272 manually recorded arrival and departure times to the platforms in question. The 24/7 effect of the platform visits was to reduce total crime counts by 14 per cent on treated platforms relative to completely unpatrolled control stations, and calls for service by 21 per cent .

Trinidad and Tobago Police Service (TTPS) have made great strides, perhaps more so than any other police organisation, in embedding an Evidence Led, hot spot patrol approach using technology rather than manual methods to track patrol. This began with a Randomised Controlled Trial testing the hypothesis that more patrol time in hot spots of violent crime would reduce harm levels for that crime (Williams, 2014). The top 40 police districts for violent crime between January 2012 and July 2013 were chosen and separated into treatment and control groups, using paired random assignment. Tracking data from GPS- fitted vehicles was used to monitor dosage of patrol and fed back in district level CompStats. Whilst no data was generated for control hot spots, the experiment resulted in a 41 per cent reduction in homicides and shootings in the experimental group when compared to control. Subsequently, a national roll out in Trinidad of tracking patrol minutes in hot spots increased patrols by 1,000 per cent and reduced homicide by 20 per cent (Kumar, 2015, as cited by Sherman and Strang, 2015).

In Dallas, providing commanders with the hours of vehicle presence in a set of high crime treatment hot spots, as measured by an Automated Vehicle Locator (AVL) system, resulted in achieving higher levels of patrol in hot spots and significant reductions in crime; however the authors found that '*AVL information will not aid patrol allocations in large geographic areas*

because patrol coverage in beats is largely a function of cross district dispatch rather than Commander specified deployment' (Weisburd at al., 2012a, p. 4). The authors conclude by stating that further research is required in other locations, focusing on hot spots, to better understand any possible value in using AVL for deployment.

Op Savvy was a Randomised Controlled Trial carried out in Peterborough, where all hot spots with 36 or more calls for service (CFS) were assigned to treatment or control, with the intended treatment being three 15 minute patrols in treatment hot spots, between 2PM and 10PM, by PCSOs monitored by GPS captured by their radios, with business as usual activity carrying on in control hot spots (Ariel and Smallwood, 2014). 81 eligible hot spots were identified and the experiment carried out, which resulted in an 8 per cent difference in the reduction in number of crimes between treatment and control. While this finding may not seem noteworthy, what is interesting is that when hot spots were broken down into 'high, medium and low' categories, crime was reduced in high and medium categories by 40 per cent but recorded crime increased in the low category by 157 per cent. Furthermore, when PCSO *and* PC patrol times and locations were analysed using GPS, it was found that while PCSOs spent 54 per cent more hours in treatment versus control hot spots, they spent more hours in medium and low hot spots, whereas PCs patrolled the hottest treatment hot spots nearly 50 per cent more and patrolled the coldest treatment hot spots 50 per cent less. Once again, this shows that GPS data is essential in explaining trends and must be used to ensure individuals are patrolling where they should be.

It is also worth noting a significant piece of analysis carried out in Hertfordshire Constabulary using Automatic Vehicle Location (AVL) data from between April 2012 and March 2013. In total 617,203 data points were analysed to establish 'available' patrol time of uniform 24/7 teams, which was then overlaid with crime and incident data to establish any discrepancy between police presence and demand (Weatherill, 2014). The resulting analysis showed a mixed alignment of available patrol time to the 3 highest demand wards in each of the three towns analysed, and a significant amount of time spent at police stations. While the study had its

limitations, for example the data included vehicle locations but no foot and cycle patrol locations, and that nothing was reported back on how these results were used in the force to change practices, the analysis was still notable in the way it sought to match police presence using GPS data to crime demand.

Summary

While this is by no means an exhaustive list of every occasion police patrols have been tracked during experiments or as part of an analytical study, it is clear that accurate and regular tracking of patrol is not the 'norm' in modern policing. Wain and Ariel summarise their 2014 synopsis on the tracking of police patrol by stating that '*the limited literature on the impact of tracking further raises a number of questions on how tracking technology can affect officer behaviour or police subculture*' (Wain and Ariel, 2014, p. 8), which is where this review of the literature will be concluded. It has been observed that hot spot patrol delivered in the required doses works and has been tested time and time again. It has been shown through more general literature on management that tracking an individual's work outputs and feeding these back, whether positively or negatively, will alter behaviour; however, praising good performance is likely to have a better effect than punishing poor performance. There remains a gap in the literature for a direct test of whether providing feedback on patrol dosage will increase said dosage, and what effect the feedback will have over time. What will be carried out and analysed as part of this thesis is therefore a Level 4 Experiment which will test the hypothesis based around the key question: '*Will providing tracking data feedback to operational officers increase the dosage of patrols delivered?*'

Chapter Three: General Hypotheses

The evidence reviewed in the previous chapter identified the gap in hot spot patrol literature: it has been suggested time and time again by experiments with high internal and external validities that hot spot patrol reduces crime (Braga *et al*., 2012). Far less research however has been undertaken on how to maintain the dosage required to observe these crime reducing effects, particularly in non- experimental conditions, where perhaps focus can be diverted elsewhere and hot spot patrol might not be seen as the highest priority when resources are thin on the ground. It has however been shown that tracking of police patrol is possible and that the feeding back of this tracking information is likely to positively influence the dosage of patrol, though this has not been comprehensively tested.

Given these gaps and assumptions, it is hypothesised that providing a weekly hot spot patrol feedback report, directly to the operational Sergeants responsible for the daily deployment of PCs and PCSOs on patrol, will have the effect of increasing dosage of patrol carried out by the patrollers in those locations. This is to be measured in terms of number of visits to hot spots carried out by the PCs and PCSOs on duty and tasked to hot spot patrol. Only one treatment condition will be tested, using a relatively 'soft' approach of disseminating the treatment report by email directly to the supervisors responsible for that location, asking for confirmation of receipt, and allowing them to act on its contents in the manner they find most appropriate.

The following chapter will describe in detail the methodology used to conduct the experiment, and will set out the data that was collected throughout the course of the study. This data will then be analysed in chapter 5, discussed in detail in chapter 6 within the context of both BTP and the literature, with conclusions and policy recommendations following in chapters 7 and 8.

Chapter Four: Experimental Methodology and Data

In this chapter, the methodology used to conduct the experiment will be explained in the form of an experimental consort. The hypothesis will be presented along with the research design to be used to test this hypothesis, the precise treatment to be deployed as part of the experiment will be outlined, and the outcomes to be tested will be given in detail. The analytical plan and statistical power will be laid out in preparation for subsequent chapters where the data will be analysed and discussed.

Research Design

The hypothesis to be tested is that providing a weekly feedback report, directly to the operational Sergeants responsible for the daily deployment of PCs and PCSOs on patrol, will increase the dosage of patrol carried out. The specific research hypothesis and corresponding null hypothesis are shown as follows.

H_0 N of hot spot visits will not be increased when weekly feedback reports consisting of tracking data from the prior week are sent to operational deployment Sergeants.

H_1 N of hot spot visits will be increased when weekly feedback reports consisting of tracking data from the prior week are sent to operational deployment Sergeants.

These hypotheses will be tested using an experiment classed as Level 4 on the Maryland Scale of Scientific Methods, defined as a '*comparison between multiple units with and without the program, controlling for other factors, or using comparison units that evidence only minor differences*' (Sherman *et al*., 1998). This means that while a number of threats to internal validity are eliminated, such as causal direction, history and chance factors, selection bias may still be present, indicating that specific factors characterising the treatment group may independently

affect the observed outcomes. Analysis of results will therefore focus not only on data aggregated by whether they are within the treatment or control group, but will also examine each group individually in a sub group analysis.

Experimental Settings

British Transport Police (BTP) is a specialist police force, responsible for policing the railways throughout England, Wales and Scotland. 8.6 million people use the rail network every day, and BTP is responsible for keeping the individuals in this transient environment safe and secure. BTP has just over 2,000 uniformed Police Constables (PCs) and around 350 Police Community Support Officers (PCSOs), with detective and management ranks, Police Staff and Special Constables making up the remainder of BTP's 5,500 strong workforce.

BTP have been using hot spot patrol on this network since the latter part of 2014 as the default patrol strategy for all uniform resources, meaning that PCs or PCSOs not doing some other form of police work as directed by their supervisor or the Force Control Room (FCR), such as taking statements, carrying out arrests, attending court or training, are to be carrying out 15 minute patrols in hot spots of crime as identified by BTP Analysts. A number of 'patrol cards' (an example of which is shown in Appendix 1) are available for each shift for each station. These are tasked out by the Supervisor on duty to the resources available for patrol on that day; these may be tasked as single or double patrol, based on the supervisors risk assessment or the Independent Patrol (IP) status of the individuals patrolling, to both PCs and PCSOs alike. The individuals will patrol as directed on the patrol card, for 15 minutes in each hot spot, until abstracted for another duty (such as an arrest or call for service) or when refreshments or comfort breaks are required; once the individual is ready to re- join the patrol, they will do so in the hot spot corresponding to the time they re- start patrolling. The patrol cards are very much the 'default' position for every PC and PCSO resource on duty.

These patrol cards have been in use for some time (albeit refreshed on a regular basis to include 'new' hot spots, and to remove 'cooled' spots), however the capacity has not been available within BTP to capture any form of meaningful data from the information noted on them manually by the individuals patrolling. Whilst they are submitted to the central project team responsible for the implementation of hot spot patrol within BTP, they are merely spot checked on an irregular basis. This experiment sought to gather the data on these patrol cards for the first time, in a meaningful way and in a format which could be used to influence patrol dosage and provide diagnostics on how the patrols are carried out in real terms.

The resulting Level 4 experiment being described here was conducted as an in- house experiment, with all management, data logging and analysis carried out by BTP employees. Resources involved with the delivery of this experiment consisted of a police staff researcher at Inspector equivalent level (the author of this thesis), the hot spot patrol Senior Responsible Owner (SRO) at Chief Superintendent level and a police staff Patrol Administrator. Additionally, the Chief Inspectors responsible for the sites to be part of the experiment were briefed and kept informed.

The experiment was carried out within BTP's 'B Division', a geographical area covering the East and South East of England (see Appendix 2 for map), an area which accounts for the majority of passenger journeys in Britain, across East Anglia, the south coast and London, including the London Underground (LU) and Docklands Light Railway (DLR). The specific experimental locations were 4 London 'hub' stations (large terminal stations with a permanent establishment of Inspectors, Sergeants and patrolling PCs and PCSOs, dedicated and ring fenced to policing only that one station): London Euston, London Waterloo (which includes London Waterloo East), London Victoria and London Bridge, the former two being the treatment stations and the latter two control.

Seven locations in total were eligible for experimentation, the 4 finally chosen were selected through a quasi random selection process, with the eligibility criteria being a station

carrying out hot spot patrol as their business as usual patrol deployment method, a 'Hub' station within B Division, with a permanent patrolling establishment of PCs and PCSOs along with an Inspector and Sergeant(s) dedicated to and ring fenced to patrolling only that hub station. Once selected, the stations were then assigned to treatment and control.

Procedure

The experiment was carried out as planned over four weeks in August, specifically between Monday 1st August 2016 and Sunday 28th August 2016. A timetable is shown as follows in Table 1 for clarity.

Table 1. Experimental timetable.

Week	Date to and from	Deadline for submitting patrol card	Date feedback report to be compiled and disseminated
Before	01/08/16 - 07/08/16	08/08/16*	08/08/16**
1	08/08/1 - 14/08/16	15/08/16*	15/08/16**
2	15/08/16 - 21/08/16	22/08/16*	22/08/16**
3	22/08/16 - 28/08/16	29/08/16*	30/08/16** +

*Morning of

**Afternoon of

+ Due to Bank Holiday on the 29/08/16

Chief Inspectors responsible for the 4 experimental sites were briefed by email one week in advance of the commencement of the experiment. The information provided was kept deliberately light, simply stating that the hot spot patrol central team were trialling a new feedback report based on the patrol card returns, and the Chief Inspectors were given a copy of the timetable for the 'trial'. They were not briefed on which sites were in the treatment group and which were in control; the word 'experiment' was deliberately not used.

Patrol supervisors in all four sites were told they would need to submit to the central team the patrol cards tasked out and completed by their patrollers, on a daily or weekly basis, by email or by internal post. The two treatment sites were told they would receive a feedback report the week following submission of those weeks patrol cards.

Patrol cards were filled in manually whilst on patrol to show visits completed by the individual PC and PCSO patrollers and sent into the central team either by internal post, or scanned and sent via email, then logged in a MS Excel spread sheet (see Table 2 on page 31 for specific information on the fields captured); a feedback report was compiled and disseminated the following week. This feedback report showed a summary of the data from the week previous, including the overall percentage of hot spot patrols 'achieved' against those 'required', a summary by day of the week, and information on the percentage of returns received (a sample feedback report is shown as Appendix 3). These feedback reports were sent by email from the BTP Patrol Administrator, to the supervisors at the two treatment sites, on a Monday afternoon. The Chief Superintendent SRO for hot spot patrol within BTP was copied into these emails.

Measurements and Variables

Variables

This experiment sought to measure change in the dependent variable of patrol dosage measured in hot spot visits, based on manipulation of the independent variable of 'patrol feedback'. The key units of analysis used to measure patrol dosage was a 'hot spot visit', defined as a uniformed PC or PCSO physically standing in a hot spot of crime. These visits were allotted in 20 minute intervals on individually assigned Patrol Cards (15 minutes for the patrol itself, 5 minutes for travel to the next location), however the capacity was not available for this experiment to log the actual number of minutes spent in a hot spot - the only unit of analysis was hot spot visits. Any visits where two individuals patrolled together on a double patrol was counted as one visit. This information was recorded by the officer at the time of patrol on a paper patrol card, which was

then submitted to the supervisor at the end of their shift and subsequently submitted to the central team for logging.

A BTP hot spot of crime is identified by BTP Analysts, and are micro locations such as train or tube platforms or shops with significantly increased occurrences of historical crime, and is identified by calculating the micro locations which account for 50 per cent of the crime in all of the micro locations over a 3 year period. For this experiment, the hot spots were already defined by in house BTP Analysts, and were not amended for the duration of the experiment.

Measurements: All Sites (Treatment and Control)

As part of the business as usual operating model for hot spot policing within BTP, PCs and PCSOs are already required to patrol in 15 minute intervals in micro hot spots of crime throughout the day when not responding to incidents or carrying out other duties as tasked by their supervisors. The officers followed a Patrol Card, which was tasked to them at their start of shift briefing by the Supervising Officer. Individuals were asked to mark on this patrol card whether or not the hot spot was visited, and this was handed in at the end of shift and sent into the central project team to be logged. Therefore, a set of 3 outcome measures were captured for the 4 weeks during which the experiment was live. These were the number of individual hot spot visits carried out by one individual on one shift, (hence forth known as visits 'completed'), double patrol visits were counted as one visit; the maximum number of possible hot spot visits which could be carried out on one patrol (hereinafter referred to as 'required' number of visits); and the number of patrols cards tasked in each station on each day for each shift.

It is important to note that 'missing' patrol cards (ones tasked out by the Supervisor to a PC or PCSO, but not submitted back to the central team and therefore whose data was not logged) were highlighted as missing in the weekly feedback report, and the potential data on visits completed and visits required was not included in the analysis to follow. For example, for clarity, if two patrol cards were tasked, each with 10 visits required, but only one was returned to the

central team, and this one patrol card showed 5 visits were completed, the percentage compliance calculation carried out would be 5/10 as opposed to 5/20.

As an additional outcome measure, the crime and calls for service volumes for each of the sites were measured for each week during which the experiment ran, in order to provide some basic conclusions on whether patrol dosage and crime were negatively correlated.

Measurements: Treatment

Measuring the treatment deployment was the simple task of noting the time and date on which the feedback was sent, along with the recipients of the email. Once confirmation was received that the report had been briefed out the time and date was also recorded. All treatments were delivered as per the timetable so no specific interventions were required.

It was decided that chasing 'missing' patrol cards would not be carried out to ensure the experiment was as close to operational, business as usual conditions as possible. It would simply be highlighted in the feedback report that there had been patrol cards not returned to the central team, and any patrol data included in the missing returns would not be captured.

Datasets

The majority of data collected was relatively simplistic and held in one MS Excel spread sheet. The fields captured are shown in Table 2. A number of fields were collected regardless of whether the patrol card was submitted to the central team, with 3 additional fields captured once the patrol card was received and logged.

Table 2. Captured datasets.

	Dataset	**Further Information**
Data logged regardless of whether patrol card was submitted or not	Patrol Date	The date on which the patrol took place
	Station Name	One of the four experimental stations
	N of hot spot patrols required	The total number of hot spot patrols possible on the patrol card. Patrol cards have hot spot visits timetabled in throughout the day without gaps for refreshments, breaks, arrests etc. Some natural non-compliance is therefore expected.
	Shift	Whether the shift was an early or late turn.
	Return submitted	Yes or no
Data logged only if patrol card was returned to central team	N of hot spot patrols completed	The number of hot spot visits as recorded on the patrol card
	Return submission method	Whether return was submitted via post or email
	Return submission date	The date on which the return was received

For an additional layer of analysis, crime and calls for service volumes were also collected for the four weeks during which the experiment was carried out in order to establish whether patrol dosage was negatively correlated to the volumes of these occurrences.

Treatment Conditions

The experiment tested one treatment condition deployed in both treatment sites: the sending of a weekly feedback report via email directly to the operational supervisors responsible for the daily hot spot patrol deployment of PCs and PCSOs within that station. The Chief Superintendent acting as the Senior Responsible Owner (SRO) for hot spot patrol within BTP was copied into each email, and the supervisors asked to confirm within 24 hours via a set template that the feedback had been received and briefed out to the PCs and PCSOs on patrol. It was not specified how the feedback was to be briefed out, this was left to the discretion of the supervisor.

The treatment was applied to the two experimental sites assigned to the treatment group and consisted of each site being asked to submit on a daily basis the total number of patrol cards tasked each day. This was submitted over the phone on weekdays to the BTP Patrol Administrator, who captured this information on a MS Excel spread sheet. The data was submitted via email on weekends and recorded on the following Monday. Each site was then given until the Monday the week following completion of the patrol to submit the completed patrol card to the Patrol Administrator. They were submitted either by internal post, or scanned and sent via email. The data on the submitted patrol cards was recorded in a MS Excel spread sheet, logging the experimental site, patrol date, patrol shift, return date, the number of 15 minute patrols anticipated and the number carried out. A patrol feedback report was then compiled consisting of a weeks' worth of data (a sample report is shown in Appendix 3). The information included consisted of the elements shown in Table 3 on page 33.

Table 3. Information included in weekly feedback reports.

Information
Total hot spot visits carried out for the week
Overall percentage for the entire week of completed hot spot patrols carried out against the total number 'required' as tasked on the patrol cards
Percentage of 'completed' hot spot patrols carried out against those 'required' for each day of the week.
Overall percentage of patrol cards returned against patrol cards deployed.
Percentage of patrol cards returned for each day of the week.
Total number of patrol cards tasked that week.

The feedback reports were sent via email to the Sergeants at that station, copying in the relevant Inspector and also the Chief Superintendent with overall responsibility for Hot Spot Patrol, and the Sergeants were given 24 hours in which to confirm they had received the report, and that it had been briefed out to their teams. This treatment was deployed as intended 4 times in total as per the timetable shown in Table 1.

Control Conditions

The supervisors at each control site were asked to submit on a daily basis the total number of patrol plans tasked that day. This was submitted over the phone on weekdays to the BTP Patrol Administrator, who captured this information on a MS Excel spread sheet. The data was submitted via email on weekends. Each site was given until the Monday the week following completion of the patrol to submit the completed patrol cards to the Patrol Administrator. They were submitted either by internal post, or scanned and sent via email. The returns were logged in a MS Excel spread sheet, logging the hub station, patrol date, patrol shift, return date, the number of 15 minute patrols anticipated and the number carried out. No further contact was made with these sites and no feedback or follow up on submitted returns took place.

Analytical Plan

Analysis will focus on examining the percentage of dosage required which was observed within the treatment and control groups in the 4 weeks during which the experiment took place (one 'before' week, followed by 3 weeks during which the experimental treatment was deployed). Patrol dosage will be measured in terms of the number of visits completed versus the number required, which is the total number of possible visits for that shift as tasked on the patrol card. An independent samples t-test and effect size (Cohen's d) calculations will be carried out to determine whether there was a significant difference between treatment and control groups. Analysis will also take place examining cumulative weekly trends within the treatment and control groups by examining the cumulative percentage change in patrol dosage each week when compared to the 'before' week. Following this analysis of treatment and control sites together, the two treatment sites will be analysed in isolation to establish whether differences were observed in the dosage between these two different locations.

Finally, the visit data will be analysed alongside crime and call for service data for the locations in which the patrols took place, to establish whether any negative correlation exists between the two. Pearson's correlation coefficient (r) will be calculated for each experimental location.

Statistical Power

Due to the short running time of the experiment (4 weeks in total) this study is significantly underpowered and hence the results will not lend themselves to further statistical testing. Furthermore, there is no comparison data available from previous months or years as this is a newly collected dataset, so the analysis will be relatively basic and will be used to facilitate identifying whether there is merit in recommending further experimentation in the form of a full Randomised Controlled Trial (RCT) at a later date.

Summary

The experiment will run for four weeks in total, one before week, and three weeks in which the treatment will be deployed. The data collection methods are manual and bureaucratic, but manageable within the timescales required for this research. Analysis will take place to make statements on statistical significance and effect size of the results. However due to the short running time, small number of sites, and limited data collected, the findings will be suggestive rather than used to make full conclusions. These findings can be used to underpin an extended and more powerful study of feedback.

Chapter Five: Findings and Results

In this section, the key focus will be on analysing the results of the experiment, highlighting correlations and trends where they exist, outlining the reasons why these occurred, and carrying out statistical testing, to establish whether any effect observed is significant. Any trends and correlations will then be discussed in the following chapter, looking at the results not in isolation, but within the context of the BTP operating environment as well as within the context of the available literature on the subject, which will lead to conclusions and policy recommendations for BTP.

Firstly, the results in terms of delivering the experiment will be explored, to analyse whether the treatment was in fact delivered as intended and whether this was recorded accurately. Then moving onto the results themselves: the overarching research question and title of this thesis: '*Does patrol feedback have any affect on patrol dosage?*' will be examined. This will be answered firstly by looking at the treatment and control sites aggregated into overall figures, analysis will however not be concluded there, as an additional subgroup analysis will be conducted, to establish whether there are any variances in dosage between the two treatment sites.

Next, analysis on day to day hot spot patrol deployment will be carried out as although this was not originally envisaged as part of this research, the data set collected for this study will be the first which can be used as an indicator for how hot spot patrol is being delivered in BTP. How many patrol cards are tasked out each day for each site? How does this vary by day of the week or by shift?

Finally, analysis of how crime and calls for service fluctuate throughout the duration of the experiment will be performed, in order to establish whether these occurrences are negatively correlated with patrol dosage. If a negative correlation exists, although a vast number of other

factors not controlled for through the experimental design might be the cause of the trend, it will still be an interesting finding nevertheless and is worth this brief piece analysis.

Experimental Delivery

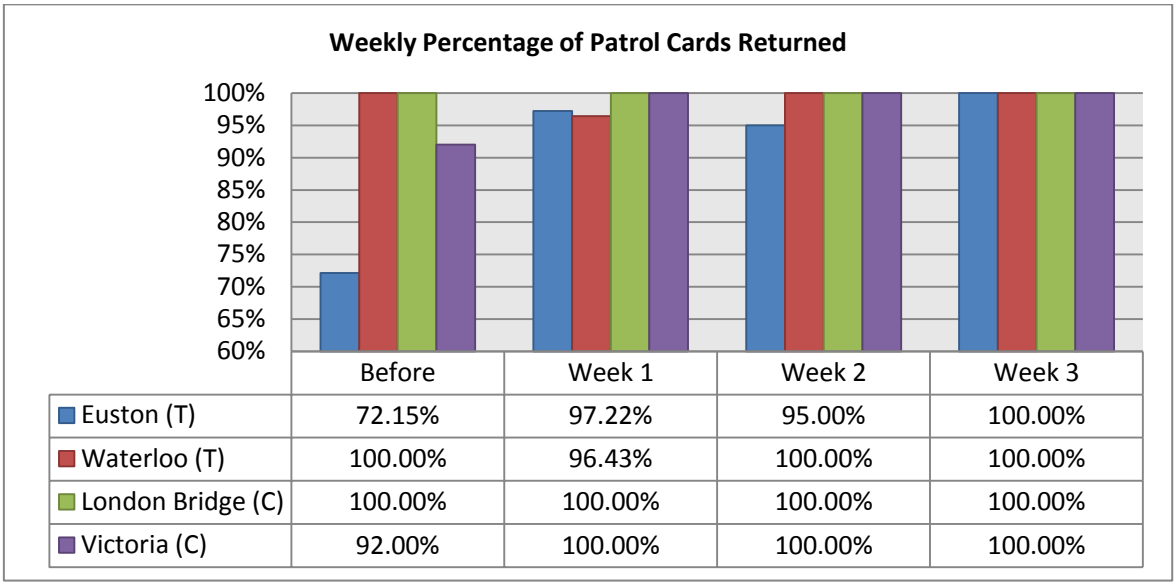
Was the experiment delivered as intended?

All eight weekly feedback reports required to be disseminated to the treatment sites (four to London Euston and four to London Waterloo) were delivered as planned (shown in Table 1 on page 27), so the experimental treatment was delivered as intended in these terms. All feedback reports took the same format each week (shown in Appendix 3), and there were no changes in the Sergeants or Inspectors at either the treatment or control sites for the duration of the experiment, so reports were sent to the same individuals each time.

However the decision was made, in part due to availability of resources to deliver the experiment, and also partly to keep experimental conditions as close to business as usual conditions, not to 'chase' patrol cards un- submitted to the central team following patrols taking place. For clarity, this means that if a site did not comply with the requirement to send all tasked patrol cards back to the central team for logging, no action was taken except to highlight this as missing on the weekly feedback report. A percentage of patrol cards returned to the team was shown for the week along with a percentage returned for each day, however this effectively means that dosage in terms of number of visits was only calculated from the returns received (repeating the example previously used, if two patrol cards were tasked, each with 10 visits required, but only one was returned to the central team, and this one patrol card showed 5 visits were completed, the percentage compliance calculation carried out would be 5/10 rather than 5/20). Figure 1 on page 38 shows the percentage of returns submitted for each site, for each week of the experiment. London Euston, one of the treatment sites, had the poorest return compliance of the four locations; however this improved each week which could be correlated to delivery of the treatment feedback reports, as missing returns were highlighted in the weekly feedback

reports. On the other hand, control station London Bridge achieved 100 per cent compliance throughout the duration of the experiment, and Victoria followed a similar albeit less pronounced trend to that observed at London Euston, indicating that the trend at Euston was most likely not caused as a result of the feedback reports.

Figure 1. Weekly percentage of patrol cards returned.

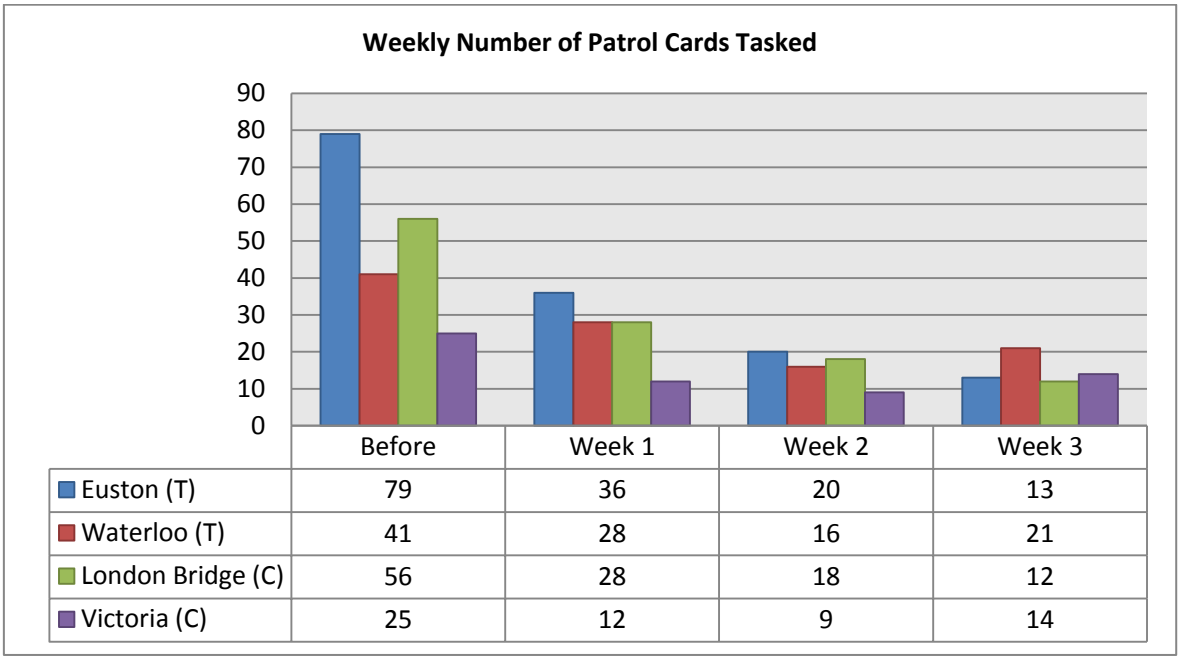


	Before	Week 1	Week 2	Week 3
Euston (T)	72.15%	97.22%	95.00%	100.00%
Waterloo (T)	100.00%	96.43%	100.00%	100.00%
London Bridge (C)	100.00%	100.00%	100.00%	100.00%
Victoria (C)	92.00%	100.00%	100.00%	100.00%

Furthermore, the number of patrol cards actually tasked to patrollers by supervisors on a day to day basis varied wildly, as the experiment did not seek to influence the daily, business as usual tasking of patrol cards to PCs and PCSOs by supervisors. Patrol cards were tasked by a supervisor based on the number of patrollers they had available for that particular shift, so would vary day to day based on a large number of variables such as annual leave, training commitments or court appearances. Figure 2 shows the number of individual patrol cards deployed for each site, for each week of the experiment. Both treatment and control sites tasked out substantially less patrols as the weeks went by, some sites even ended the experiment in week 3, tasking less than a quarter of the patrol cards tasked in the before week - for example London Euston, who deployed 79 patrols in the before week, compared to just 13 in the entire last week (Week 3), a percentage reduction of -83.5 per cent. This could be due to the imminent launch of 'Night Tube' on the 19th August 2016, which fell during the 2nd treatment week and meant a large number of

resources across all London locations were diverted to focus their attention on this event. This change is observed in both treatment and control groups, indicating the treatment was not responsible for the change.

Figure 2. Weekly number of patrol cards tasked.



	Before	Week 1	Week 2	Week 3
Euston (T)	79	36	20	13
Waterloo (T)	41	28	16	21
London Bridge (C)	56	28	18	12
Victoria (C)	25	12	9	14

Analysis from this point onwards will be carried out in terms of 'proportion' or percentage of visits carried out ('completed' versus 'required', as recorded on each individual patrol card), rather than actual number of visits, to allow comparison between sites with different numbers of 'required' patrol visits each shift, each day and each week, due to different volumes being tasked by Supervisors based on number of available resources that shift. Carrying out any sort of statistical testing on actual number of visits would not be representative of the varying number of visits required across sites. The key research question of whether feedback had any effect on patrol dosage will be examined in the next section.

Patrol Dosage: Treatment versus Control

Was a change in patrol dosage observed at the treatment stations during the experiment?

The overall answer to this question is no. An independent samples t-test was completed to determine whether there was a significant difference between treatment and control groups, comparing the proportions of patrol visits completed versus patrol visits required for each group (Table 4). There was no statistically significant difference at the 95 per cent Confidence Interval (CI) in the proportion of hot spot visits carried out between the treatment group (M = 0.378, SD = 0.135) and control group (M = 0.511, SD = 0.021) in the before week; t = -1.381, p = 0.301. There was no statistically significant difference in the proportion of hot spot visits carried out between the treatment group (M = 0.399, SD = 0.009) and control group (M = 0.439, SD = 0.116) in week 1; t = -0.492, p = 0.671. There was no statistically significant difference in the proportion of hot spot visits carried out between the treatment group (M = 0.525, SD = 0.136) and control group (M = 0.589, SD = 0.030) in week 2; t = -0.653, p = 0.581. There was no statistically significant difference in the proportion of hot spot visits carried out between the treatment group (M = 0.488, SD = 0.061) and control group (M = 0.538, SD = 0.089) in week 3; t = -0.656, p = 0.579.

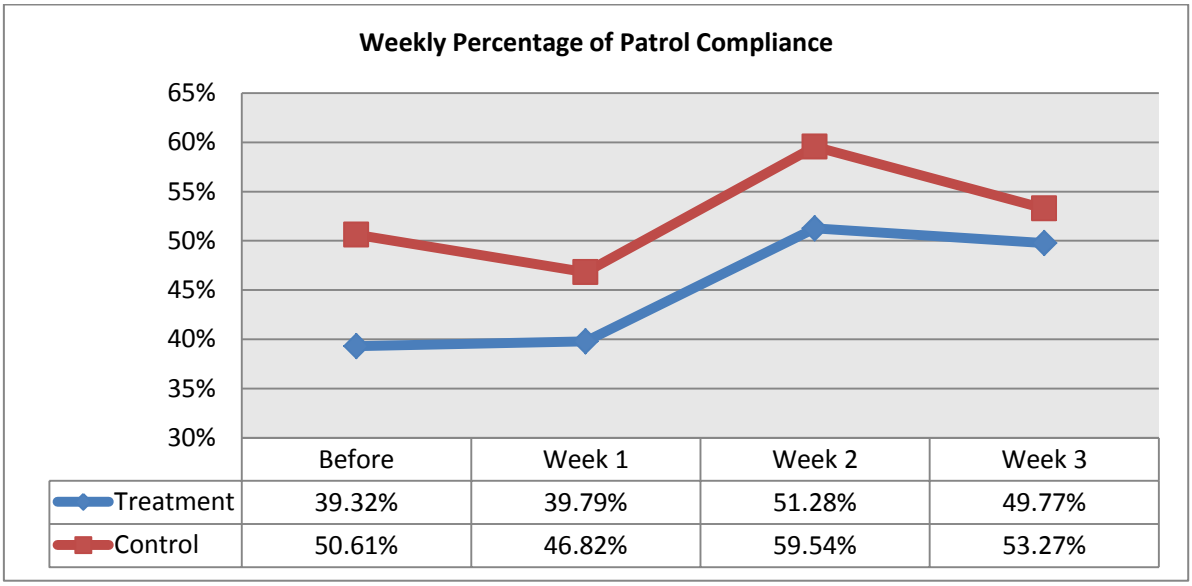
Table 4. Statistical analysis.

	Before			Week 1			Week 2			Week 3		
	Proportion	M	SD	Proportion	M	SD	Proportion	M	SD	Proportion	M	SD
Treatment	0.393	0.378	0.135	0.398	0.399	0.009	0.513	0.525	0.136	0.498	0.488	0.061
Control	0.506	0.511	0.021	0.468	0.439	0.116	0.595	0.589	0.030	0.533	0.538	0.089
t value	-1.381			-0.492			-0.653			-0.656		
df	2			2			2			2		
p (sig. 2-tailed)	0.301			0.671			0.581			0.579		
Cohens d	-1.381			-0.492			-0.653			-0.656		

When the visits for the two treatment sites are summed and calculated as percentage compliance (visits completed over visits required), there are very similar fluctuations when compared to the percentages for the control sites. Figure 3 on page 41 shows these fluctuations in terms of percentage compliance each week, showing a similar compliance in the before week and in week 1 in both treatment and control, increasing in week 2 to a greater level than in the

before week, then decreasing slightly again in Week 3. The fact that these fluctuations follow very similar patterns in both treatment and control groups indicates that these changes are not a result of the experimental treatment. Furthermore, effect size (Cohen's d) calculations show that the 'effect' between treatment and control sites is most pronounced in the before week (d = -1.381), when the treatment was not even deployed. The effect reduces in week 1 (d = -0.492), then increases in week 2 (d = -0.653) and week 3 (d = -0.656) indicating the treatment may be beginning to take effect. Perhaps if the experiment had been run for a longer duration, effect sizes would have increased in subsequent weeks, and a stronger correlation between the treatment being deployed and patrol dosage would have been observed. The experiment was however constrained by the requirement to present experimental data in September, meaning it was not possible to run the study for a longer period. This will be discussed in more detail, along with recommendations for a future experiment with higher power, in the next chapter.

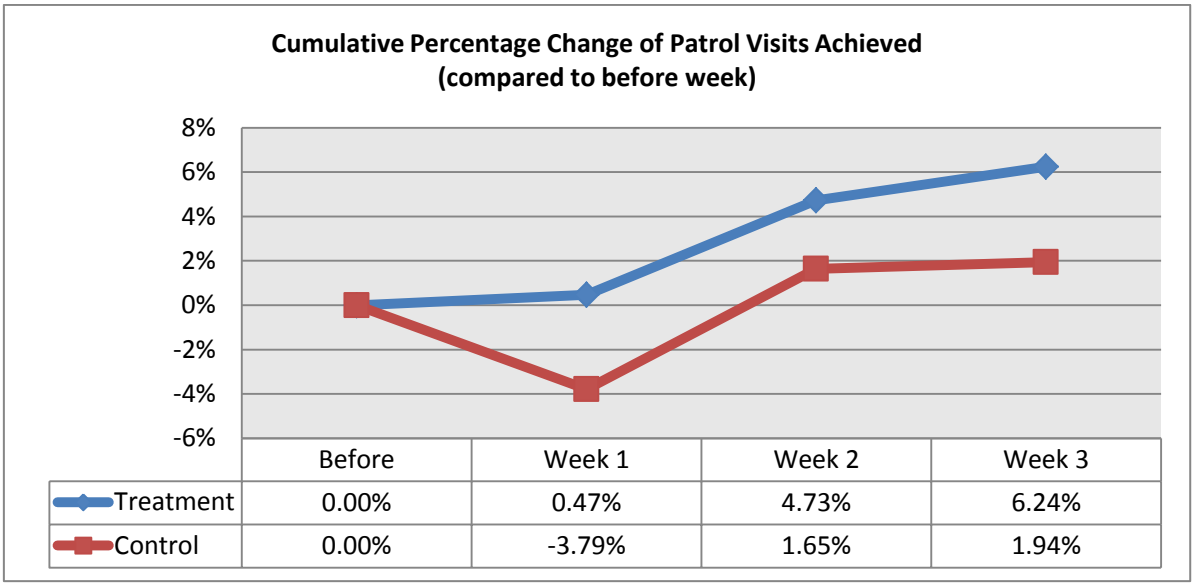
Figure 3. Weekly percentage of patrol compliance



	Before	Week 1	Week 2	Week 3
Treatment	39.32%	39.79%	51.28%	49.77%
Control	50.61%	46.82%	59.54%	53.27%

The trend of treatment and control showing similar percentage compliance is further demonstrated when percentage patrol compliance is calculated cumulatively over the three treatment weeks, and the difference between this cumulative compliance and the before week compliance is calculated. Near identical fluctuations in percentage difference are observed in both the treatment and control sites (Figure 4), however the difference in percentage compliance does show an increase in the treatment sites in week 1 by 0.47 per cent, whereas in the control sites compliance decreases by 3.79 per cent. In both treatment and control sites, in weeks 2 and weeks 3 (cumulatively) patrol dosage increases to a higher level than in the before week.

Figure 4. Cumulative percentage change of patrol visits achieved.



	Before	Week 1	Week 2	Week 3
Treatment	0.00%	0.47%	4.73%	6.24%
Control	0.00%	-3.79%	1.65%	1.94%

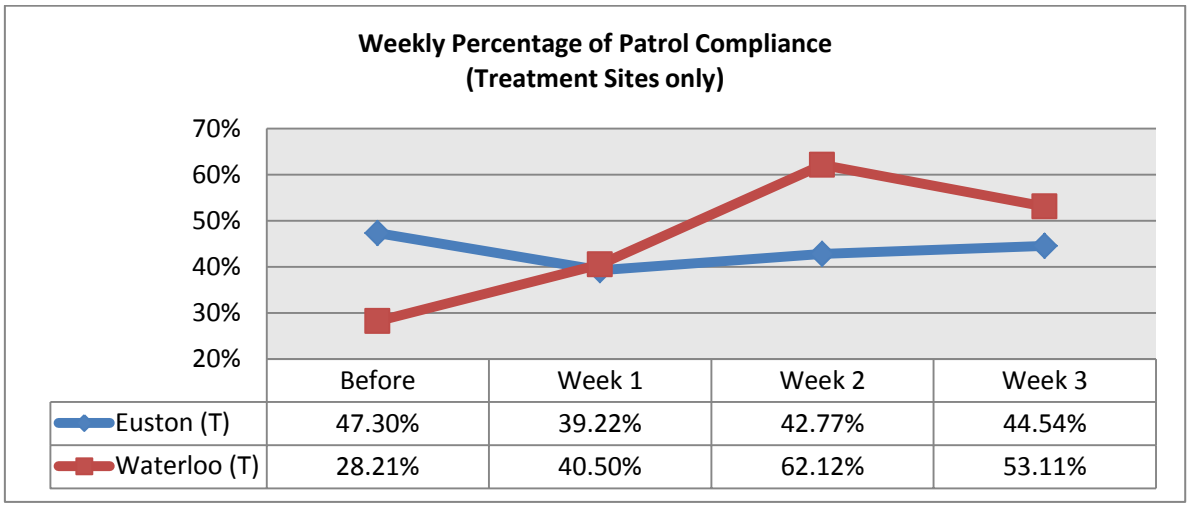
Patrol Dosage: Sub Group Analysis

Was any effect observed in either of the treatment sites when analysed in isolation?

When the two treatment sites, London Euston and London Waterloo, were analysed separately and percentage compliance was calculated for each week of the experiment, while London Euston shows no substantial improvement, London Waterloo saw a dramatic increase in visits achieved. For London Waterloo, percentage compliance in the before week was at 28.2 per cent, which increased to 40.5 per cent in week 1, 62.1 per cent in week 2, concluding the experiment at 53.1 per cent in week 3, a percentage dosage still nearly double that which was observed in the before week. Figure 5 shows the percentage compliance for each week for each location separately.

The reasons why it is believed these changes occurred will be discussed in detail in the next chapter, however it is thought that this is due to the strength of the individual leaders responsible for policing at London Waterloo. The location has seen strong and consistent leadership for several years now, with a long in service and highly respected Inspector acting as Officer In Charge (OIC), whereas London Euston has had a number of management changes in recent years, culminating with the appointment of a temporary Inspector three weeks prior to the commencement of the experiment, indicating there may be a correlation between leadership skills and the patrol dosages observed.

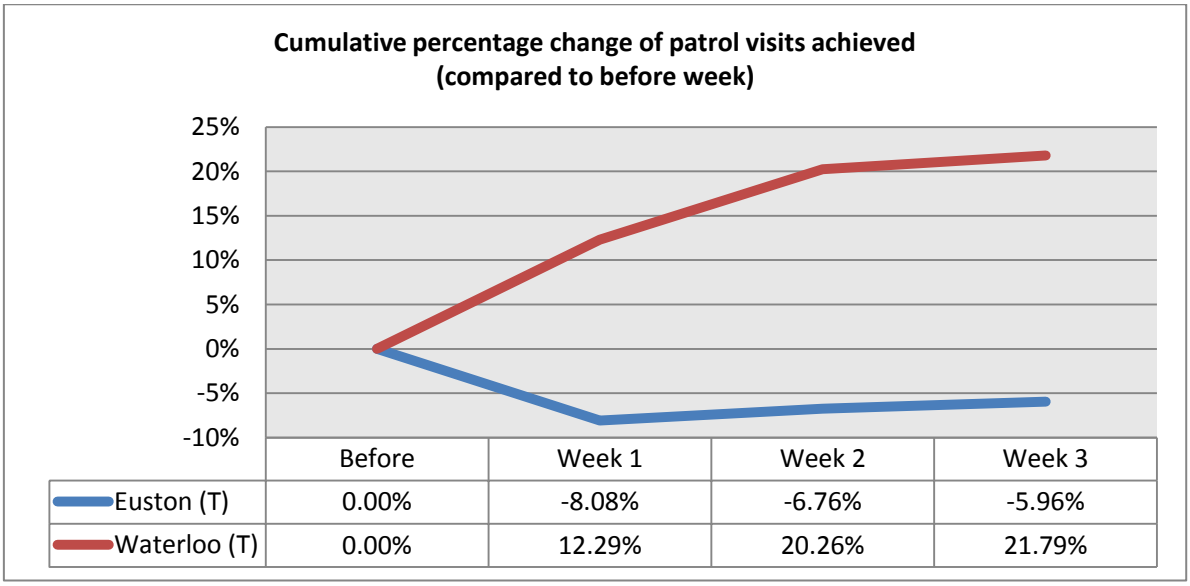
Figure 5. Weekly percentage of patrol compliance (London Waterloo and London Euston only).



	Before	Week 1	Week 2	Week 3
Euston (T)	47.30%	39.22%	42.77%	44.54%
Waterloo (T)	28.21%	40.50%	62.12%	53.11%

When compliance was calculated cumulatively as percentage change from the before week compliance, at London Euston percentage compliance was the highest in the before week when the treatment had not even yet been deployed, with the cumulative compliance in the three following weeks being lower than the before week, as is clearly observed from the graph in Figure 6. London Waterloo, on the other hand, shows a substantial increase in patrol dosage in each of the weeks following deployment of the treatment feedback reports.

Figure 6. Cumulative percentage change of patrol visits achieved (London Euston and London Waterloo only).



	Before	Week 1	Week 2	Week 3
Euston (T)	0.00%	-8.08%	-6.76%	-5.96%
Waterloo (T)	0.00%	12.29%	20.26%	21.79%

Supplementary Analyses

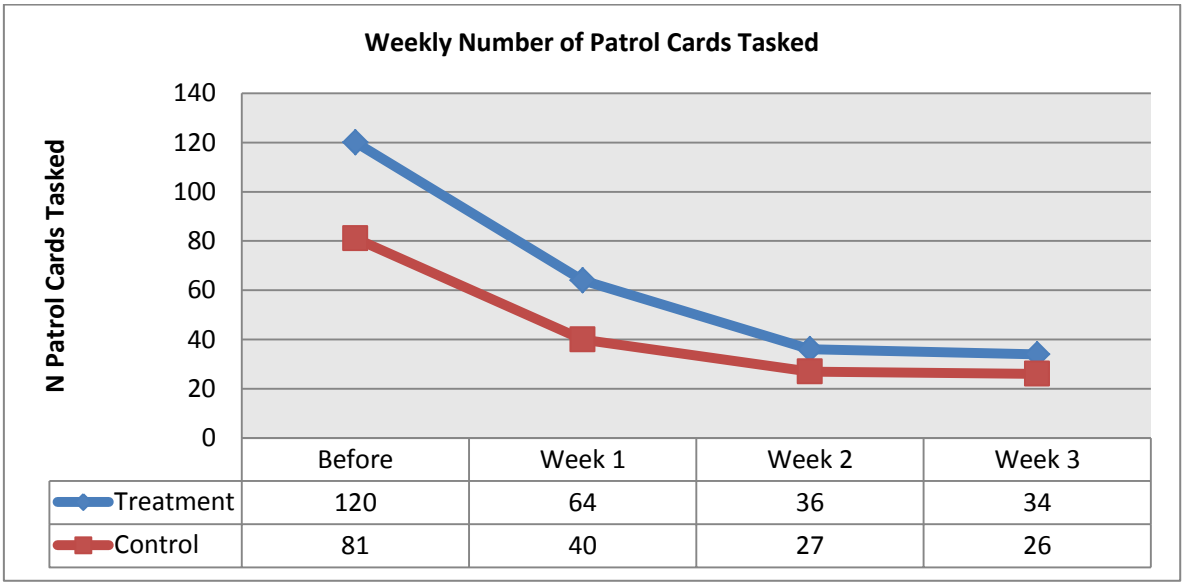
The dataset gathered for the purpose of this thesis was the first time within BTP that any meaningful data on either patrol card tasking or actual hot spot visits was collected in a format suitable for in depth analysis. While the principle research question of whether feedback will influence patrol dosage has been answered in part in the previous section and will be discussed in more depth in the next, a host of other important inferences can be drawn from the data which can be used as an indicator of how hot spot patrol in general is being managed at BTP. These findings will therefore be outlined here, as the conclusions and subsequent recommendations to be made in a later chapter, if put into practice, could remarkably enhance BTP's hot spot patrol delivery. These findings focus on the volume of patrol cards tasked on a weekly, daily, and shift basis by supervisors.

It has been previously shown that uniform officer patrols in hot spots of crime will reduce crime (Braga *et al*., 2012). BTP analysts will create sufficient patrol cards to allow the maximum possible number of PCs and PCSOs on duty at a particular site or station to patrol in single patrol, ensure each hot spot is patrolled a certain number of times in a 24 hour period, and that hot spot visits by officers do not overlap. Supervisors are responsible for the day to day tasking of patrol cards to the resources they have on duty for that particular shift. There is no central oversight of this tasking and hence no challenge should patrol tasking fall below that required to ensure each hot spot is visited a certain amount of times per day.

Patrol cards deployed in the final week of the experiment were on average only 36 per cent of what they were in the before week of the experiment. Figure 7 on page 46 shows the change in number deployed each week of the experiment. The same change is observed across the board in both treatment and control sites, indicating that the experimental treatment was not the cause of this change. It was previously postulated that this may have been caused by the imminent launch of Night Tube, hence resources being diverted to other locations. Another possible theory is that the weeks during which the experiment was carried out were in the middle

of the prime season for summer annual leave, perhaps meaning fewer resources than usual were on duty and available for patrol. Essential to the success of hot spot patrol within BTP is the need to know centrally what every PC or PCSO has been tasked with each time they are on duty and not tasked with hot spot patrol. It is not good enough to simply assume that a supervisor is targeting their resources most effectively, as is currently the case by allowing managers to deploy at their own discretion. Some supervisors, engaged with hot spot patrol and accepting of the fact that hot spot patrol will reduce crime, will ensure that as many individuals as possible will be tasked to hot spot patrol, whereas others will fail to deploy adequate resources to cover hot spots and allow resources to be diverted elsewhere.

Figure 7. Weekly number of patrol cards tasked.

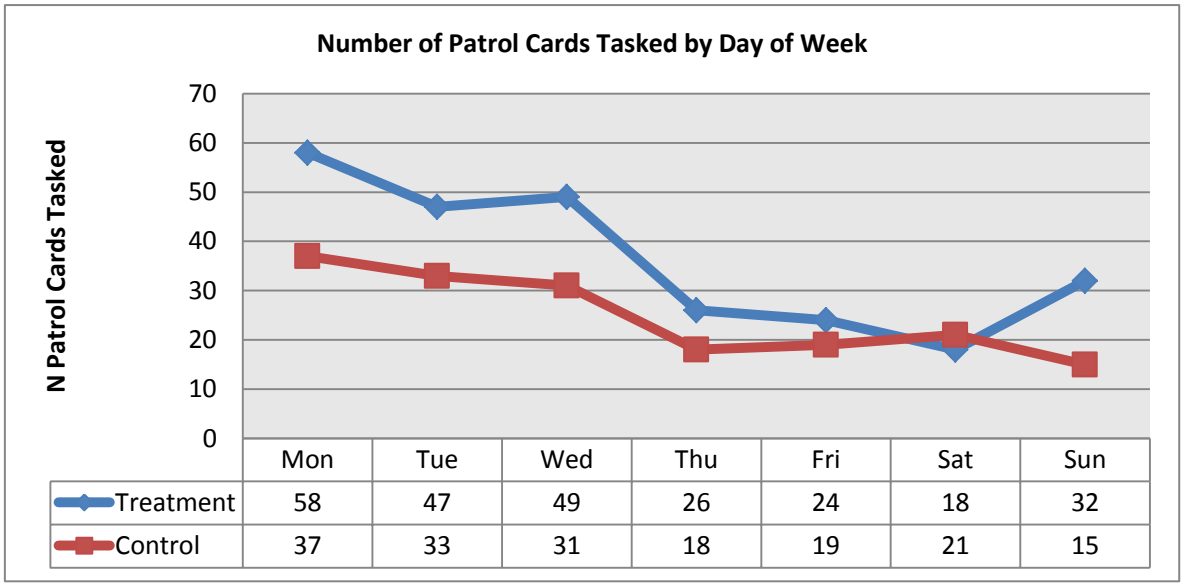


	Before	Week 1	Week 2	Week 3
Treatment	120	64	36	34
Control	81	40	27	26

When the same data on patrol cards tasked is analysed to show deployment by day of the week (shown in Figure 8 on page 47), intriguingly, the volume of patrol cards tasked reduces pointedly on Friday and Saturday, the two days continuously shown to have significantly higher crime throughout BTP locations. It can be argued that preventative hot spot patrol on these days is the most important and should be prioritised over and above other activities, not the opposite, which is what seems to be happening with patrol deployment being the highest on a Monday, Tuesday and Wednesday. This reiterates the point previously made that more data is required in

future as to exactly how and where supervisors are deploying their resources, as they may not be targeted to where they will have the most crime reducing effect.

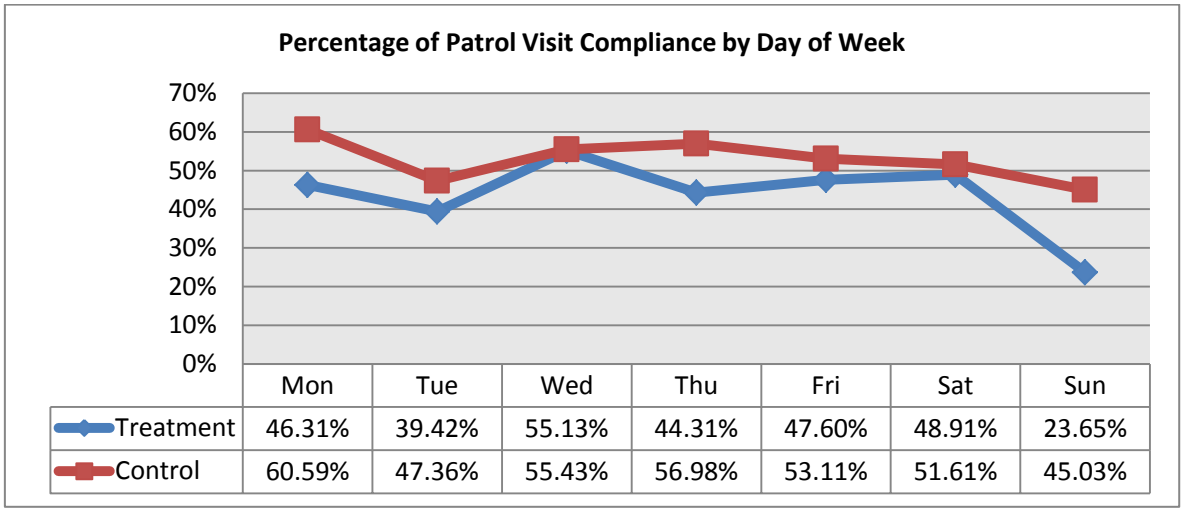
Figure 8. Number of patrol cards tasked by day of the week.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Treatment	58	47	49	26	24	18	32
Control	37	33	31	18	19	21	15

Furthermore, when percentage patrol compliance is calculated for each day, compliance does not increase on a Friday or Saturday, perhaps as it should, as this is when crime is at its highest and when hot spot patrol would be most effective. Without data on exactly what resources were doing instead of hot spot visits, it is difficult to come to a conclusion as to why this trend is observed, with a vast number of possible reasons for the decreased patrol deployment, including arrests, court warnings, annual leave or training.

Figure 9. Percentage of patrol visit compliance by day of the week.



	Mon	Tue	Wed	Thu	Fri	Sat	Sun
Treatment	46.31%	39.42%	55.13%	44.31%	47.60%	48.91%	23.65%
Control	60.59%	47.36%	55.43%	56.98%	53.11%	51.61%	45.03%

Also quite importantly, the data has highlighted that there does not appear to be a priority to task individuals to preventative hot spot patrol during late shifts, when crime is at its highest. In fact, over all four sites, there were slightly more patrol cards tasked on an early shift as opposed to late, with 51.9 per cent of all patrol cards tasked in the 4 weeks during which the experiment ran being tasked on early shifts. In the control sites, the difference was even more marked, with 57.1 per cent tasked in early shifts. More work is required to analyse hot spot patrol tasking alongside data on officer availably and officer rosters to establish whether this trend is observed simply because more officers are rostered for an early shift, hence more are tasked with hot spot patrol.

Repeating the previous assertion included in the literature review chapter: crime concentrates (Sherman et al., 1989; Sherman, 1995; Sherman, 2007; Weisburd, 2015). Crime volumes vary vastly by time of day and day of week (Sherman, 1992). BTP data for London Waterloo shows that 53.0 per cent of all crimes occur between 4PM and 12AM, and similarly at London Euston that 51.3 per cent of all crime occurs between 3PM and 9PM. What is therefore interesting is the fact that hot spot patrol deployment does not mirror these trends. A national Her Majesty's Inspectorate of Constabulary (HMIC) report on officer patrols by time of day and day of the week showed chronic under resourcing in periods when crime is at its highest, with a higher ratio of patrols taking place in low crime times, to the point where more officers were on patrol on Monday mornings than on Friday nights (Her Majesty's Inspectorate of Constabulary, 2010, p. 3).

Due to the process in which patrols are tasked in BTP – at the discretion of supervisors, paper based and largely unnoticed centrally with no broad oversight or challenge, BTP currently captures no central data on the volume of patrol cards allocated each day (other than specifically for the data collected for this research), meaning that analysts cannot even conclude with certainty that sufficient patrol cards are being tasked each day in order to patrol the hot spots enough times to have a crime reducing effect, let alone enough to allow abstraction through

expected daily activities such as arrests or refreshment breaks. This cannot continue in the long run, as this certainly is not an evidence led model which makes best and most efficient use of police resources.

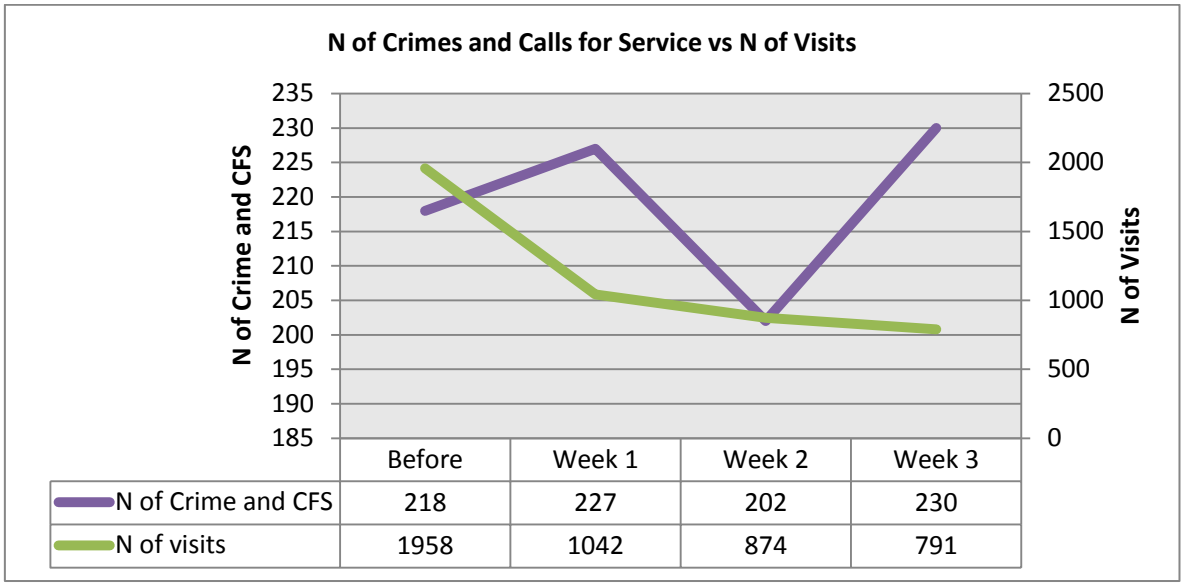
Correlation of Patrol Dosage to Crime and Incidents

Another interesting feature of this research and the data that was collected was whether or not it could be established that patrol dosage was negatively correlated to crime and calls for service. Table 5 shows the number of crimes and calls for service along with the number of patrol visits for each location, for each week of the experiment, shown graphically in Figure 10.

Table 5. Number of crimes, calls for service and patrol visits for each experimental location.

		N of Crimes	N of CFS	N of visits
London Euston (T)	Before	9	41	702
	Week 1	9	51	333
	Week 2	16	40	216
	Week 3	12	60	151
London Waterloo (T)	Before	19	49	301
	Week 1	14	51	275
	Week 2	13	48	246
	Week 3	17	47	282
London Bridge (C)	Before	5	23	637
	Week 1	4	25	328
	Week 2	6	24	278
	Week 3	2	24	184
London Victoria (C)	Before	23	49	318
	Week 1	16	57	106
	Week 2	12	43	134
	Week 3	12	56	174

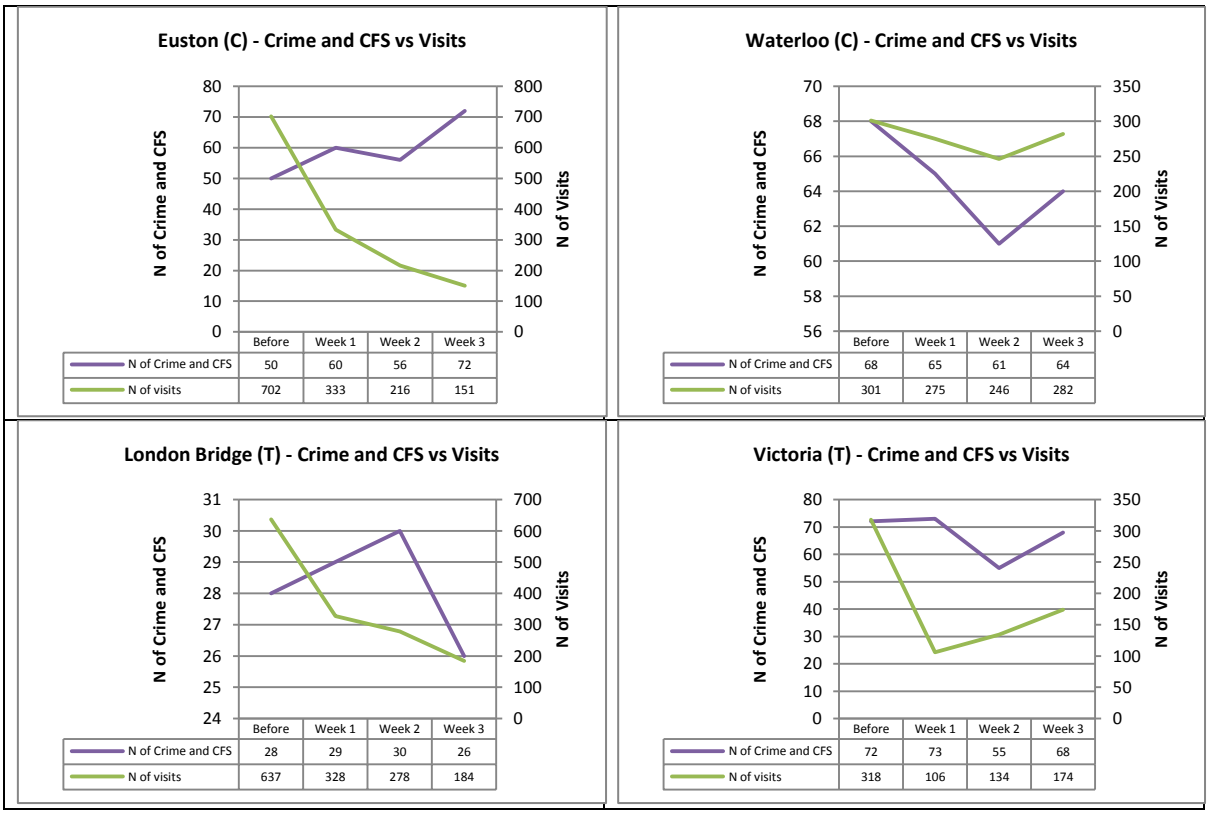
Figure 10. Number of crimes and calls for service against patrol visits.



While it is interesting that in week 1, where the number of visits decreases substantially and the number of crimes and of calls for service occurring increase, the trend is not observed in week 2, where there is then a large drop in crime and calls for service in comparison to week 1, but the number of visits remains relatively constant. In week 3, while visits remain similar to weeks 1 and 2, crime then spikes dramatically to its highest level of the entire 4 week period during which data was captured. When the Pearson correlation coefficient (r) is calculated for the two sets of variables, r = -0.04655, indicating little to no correlation between visits and crime and calls for service in this dataset.

When analysed individually (shown graphically in Figure 11 on page 51), only London Euston shows a strong negative correlation between crime and calls for service versus patrol visits, with a correlation coefficient of r = -0.78283. London Waterloo (r = 0.95643) actually shows a positive correlation between patrol visits and crime and calls for service, and both London Bridge (r = 0.15847) and London Victoria (r = 0.33811) show weak positive correlations.

Figure 11. Number of crimes, calls for service and patrol visits for each of the four individual experimental locations.



It has been suggested previously countless times that uniformed police visits to hot spots of crime would significantly decrease the crime in those locations (Braga *et al*., 2012). Why was it the case here that this was not observed? As it has been made clear previously, these results should be treated with caution, as the experimental power was not high enough to draw conclusions from the data. Furthermore, threats to internal validity were present through the experimental design, any number of which could have been responsible for these somewhat perplexing results. What is required is a full Randomised Controlled Trial (RCT), in which all threats to internal validity are eliminated and where experimental power is increased through using a different experimental design. It could indeed be the case that there is no correlation between the two variables, however only a full RCT will be able to determine with more certainty whether the results are valid. An RCT which was carried out by the Metropolitan Police Service (MPS) on the London Bus network, an environment from which similarities can be drawn with BTP in so far that both have a

transient population, actually showed a backfiring effect where victim generated crime increased when hot spot patrol was used (Ariel and Partridge, 2016). It was theorised that offenders could actually anticipate and predict the temporal and spatial pattern of long term hot spot policing as the hot spots themselves were relatively small and predictable. The concept behind hot spot policing is the perception on the offenders' part that the risk of apprehension is amplified, which is negated if offenders can foretell the threat of apprehension by predicting when a police officer will definitely not be present. It may even be the case that if a similar experiment is run within BTP, similar effects could be observed.

Summary

The experimental treatment was delivered as planned in terms of the feedback reports being collated and disseminated as per the experimental timetable, allowing an in depth analysis to take place using the data gathered, although the study was underpowered due to the short running time. It was discovered that while *overall* there was no effect on patrol dosage when tracking feedback was provided, effect varied by location, with one in particular showing a substantial increase in hot spot patrol visits when weekly feedback was deployed.

An added bonus to having this data set available for analysis was its use as an indicator for how hot spot patrol is being managed within BTP. It has been found that deployment is not temporally evidence based, with a large proportion of patrol cards being tasked on days of the week when it has been shown statistically that less crime occurs, and near equal proportions of patrol cards being tasked on early shifts as were tasked on late shifts, even though a larger proportion of crime occurs during late shift hours. Finally, no correlation was observed between visits and crime and calls for service. All of these findings will be discussed in the following chapter, with analysis as to why these may have been observed.

Chapter Six: Discussion

This section will concentrate on discussing the main findings and attempting to explain why the observed results occurred, within the context of BTP and more broadly within the literature. The findings showed *overall* that tracking feedback had no effect on patrol dosage, but the effect varied substantially between the two treatment groups. The reasons for this phenomenon will be explained here.

This chapter will begin by exploring the setting in which the experiment took place and the organisational conditions which led to the experimental treatment being deployed in the way in which it was. Next, an examination of the experimental delivery will be carried out, followed by a discussion on the observed effect of patrol feedback on patrol dosage. I will then discuss the findings in the context of the discrepancy between actual local daily hot spot patrol deployment by supervisors and the 'evidence' of when deployment would have the strongest effect. Finally, the correlations between patrol dosage and crime and calls for service will be examined. This chapter will conclude by summarising the limitations of this study, and then be followed by chapters summarising the research implications and corresponding conclusions.

Experimental Settings

The experiment reported here was not the one originally planned for this research. BTP are looking to invest in an automatic officer tracking solution, yet there has been a real organisational struggle to achieve this goal. The most common systems available rely on GPS signal, but there is no signal underground or in stations that are indoors, which form a large part of BTP's jurisdiction. Many options have been discussed and tested, with the preferred method being WiFi Access Point (AP) Triangulation, however numerous obstacles have meant deployment of smart phones required to geo- locate police officers and PCSOs in this manner has been delayed over and over and is not likely to be implemented any time soon.

Due to this delay, BTP is now considering an interim tracking solution using Bluetooth Proximity Detectors (henceforth to be referred to as 'beacons') physically placed in hot spots of crime to locate individuals, who are carrying a low cost, low functionality smartphone with software which captures their proximity to a beacon. This study was expected to use the data collected from these beacons to provide automated patrol dosage feedback to two sites, in a similar fashion to the manual data feedback which ended up being used; however once again, due to numerous IT Department failings to deploy these devices in a timely manner, the experiment had to be amended. Instead, data manually collated and self- reported by the police officers and PCSOs was used. These are less than ideal settings (see discussion in Wain and Ariel, 2014). The findings are nevertheless informative.

At face value, it appears that the experiment was delivered as planned, this was however only feasible due to the short running time of the experiment. The method of gathering and recording data on dosage was time consuming and bureaucratic. Each patroller was required to manually capture the hot spots he or she had visited on a paper patrol card, which was then submitted to a supervisor, who then sent this into the centre for logging. These were recorded by an administrative member of police staff, and in turn they became the data used to create the weekly feedback reports. Just the manual logging of visits by the BTP Patrol Administrator alone would have been a considerable investment in terms of employee time spent. Each patrol card would have taken approximately one minute to log, with 428 being logged throughout the duration of the experiment. This equates to just over 7 hours of time, which - considering this is for only 4 stations over a month long period - if extrapolated to the whole of BTP's patrolling workforce on a permanent basis, could be a full time job for two individuals (see also Ariel and Sherman, 2012). Moreover, there is the risk of high rates of human error; an officer may forget to log their hot spot visit or fill in the patrol card retrospectively, forget to record visits, or embellish the number of visits carried out. The administrator may type the number of visits incorrectly and the paper patrol cards may be lost completely. The list of interferences could go on.

It is clear that if BTP wishes to continue hot spot patrol as their main patrol method, an automatic hot spot patrol monitoring system must be prioritised and invested in. Due to the unique environments where BTP hot spots are located, different to all other UK police forces, they cannot rely on Airwave GPS to provide accurate tracking data, so investment in new technology is required. While the hypothesis that patrol feedback can increase patrol dosage has only been partially supported by the evidence gathered for this thesis, based on previous literature (e.g., Sherman *et al*., 2014), it remains the most promising avenue for reducing crime and disorder in BTP environment. More experiments are required which analyse data captured by an automated system, for a longer time period, and with more varied treatment conditions, in order to determine the best approach to track through evidence based testing – however overall, the theoretical mechanism behind the feedback loop remains the same.

The one strong conclusion which can be drawn from the data gathered for this research is that BTP's patrol deployment practices are insufficient. The ideal solution would be a review of BTP demand alongside a review of actual rosters, to analyse where gaps and misalignments exist. However, this is a major undertaking, as rosters are rooted deeply in officer employment contracts and would require a phenomenal amount of work to unpick and revolutionise. As an interim, and perhaps more palatable solution, it needs to be made clear to supervisors that resources should not be diverted from preventative patrol during times and days of high crime, and this should be tracked and challenged centrally. Research in Sacramento Police Department revealed that 75.1 per cent of officers felt new ideas and change initiatives implemented by Commanders were 'passing fads' which would soon pass and practices would return to how they were before (Lum et al., 2012). Performance management needs to be used for supervisors who fall into this category, otherwise there is a danger that hot spot patrol will not be embedded and these individuals will have been successful in their mission to keep things as they were previously.

Explaining the Results: Patrol Dosage

Toothless intervention?

When analysing the results for both London Euston and London Waterloo combined, there was no overall effect to show that providing patrol feedback on hot spot patrol would increase visits. Why? Firstly, it is necessary to look a little deeper into the exact method with which in the treatment was administered. The completed patrol cards, which had been tasked by a supervisor to a PC or PCSO who was responsible for carrying out the visits shown on the card and who recorded their visits on the same card, were sent into the centralised project team's Patrol Administrator. It was this administrator who then recorded the data from the patrol cards in a spread sheet and shared this with the author of this thesis in order for the feedback report to be put together. The report was then sent back to the Patrol Administrator, who delivered the feedback to the Sergeants and Inspectors for each location (separately for each location), copying in the Chief Superintendent with overall responsibility for hot spot patrol in BTP.

Could it be the case that the Patrol Administrator sending the feedback reports caused the lack of effect on patrol dosage observed? The feedback reports, whether they included satisfactory or dissatisfactory patrol dosages for the previous week, was sent by email from the Administrator without much in the way of commentary, and except for a request of confirmation that the report was delivered, there was no threat or consequence of any decreasing patrol week on week. Could this be what was termed a 'toothless' threat (Ariel, 2012), where it was perceived by patrol supervisors that the central hot spot patrol team were having to rely on convincing individuals to increase patrol visits rather than forcing them with a threat which would materialise if action was not taken? It has been reiterated within BTP to operational supervisors for some time that individuals need to comply with and prioritise hot spot patrol, and the feedback reports themselves were highlighting poor compliance. However, if nothing was done about it up until that point, and if official reports were showing poor compliance but were disseminated without any concern or consequence, then what motivation was there to improve? Perhaps a 'real and

certain' threat of sanction for poor performance would influence patrols to a greater degree than that was observed in this experiment (on certainly of punishment, see Nagin, 2013). Izatt-White and Saunders (2014) reinforce this requirement for action rather than empty threats when trying to enact change, by theorising that where individuals will not change, they must be removed from the organisation in order to enable the change.

Conversely, there was no praise of good performance featured in the treatment deployed as part of the experiment. If a location dramatically increased their patrol dosage from the previous week, there was no 'pat on the back' or praise for the upturn in visits. Kahneman (2011) suggested that rewards for good performance would work better than punishment of mistakes. While at London Waterloo increases in visits were observed when the treatment was deployed (more on this in the next sub chapter), consistently high dosages may not have been maintained in the longer term if no praise was given. Supervisors may start assuming that the patrols are not high enough priority strong performance was not attracting any praise and may eventually divert their attention elsewhere.

Treatment Variations in Euston and Waterloo Stations

Varying Leadership Styles

As shown earlier, different outcomes were produced in the two treatment sites. At London Waterloo, patrol dosage increased considerably following deployment of the treatment, whereas at London Euston not only was there no positive change, but dosage was actually lower than the baseline. How can these differing results be explained? The same planned treatment was deployed, at the same time on the same day. The stations are both similar in that they are both large 'hub' stations and part of the same BTP Division with the same Chief Superintendent responsible for both locations, and both with the same policing objectives, targets and challenges. So why did one respond so positively to patrol feedback and not the other?

First, while the supervisors were asked to confirm receipt of the feedback report and confirm the contents had been briefed out to those PCs and PCSOs patrolling, the experimental procedure did not specify how the feedback was to be briefed. Interviews with the sergeants at the experimental sites after completion of the experiment revealed that the method of briefing varied from person to person and place to place. Some simply forwarded on the report to their patrollers by email; some discussed it in the morning briefing. This begs the question as to what the best mechanism for providing feedback is, the one which will have the greatest positive impact on the patrol dosage.

The primary mechanism seems to be the human element: differing management styles and capabilities. London Waterloo has experienced strong and consistent leadership for several years with the same Inspector responsible for the location for a prolonged period. This leader is well respected for his knowledge and experience. On the other hand, at London Euston a temporary Inspector was appointed with responsibility for this station just three weeks prior to commencement of the experiment. This temporary Inspector is not as well respected, and it could be the case that as he was busy settling in, making preventative patrol did not seem to be a priority for him. What is clear is that the Inspector at London Waterloo was proactive and used the contents of the feedback reports to improve on his location's performance, through face-to-face meetings. The inspector at London Euston did not.

Leadership is thus a key driver of the results, and specifically transformational leadership. There are four dimensions of transformational leadership (Judge and Piccolo, 2004). First, '*charisma*' is required, where a leader displays conviction and appeals to the individuals they are managing on an emotional level. Second, '*inspirational motivation*' refers to a leader who eloquently articulates a vision which is attractive to followers. Third, '*intellectual stimulation*' requires that the leader will challenge assumptions and take risks. Fourth, '*individualised consideration*' is needed as well, where the leader is seen to be focused and responsive to the

followers' needs. These traits are observed in the Inspector in charge of London Waterloo, but not the individual responsible for London Euston.

Transactional leaders have three dimensions: '*contingent reward'*, where the manager will set out expectations and rewards for when those expectations are met, and active and passive forms of '*management by exception'*, where the leader will take corrective action based on the results achieved by the follower (Judge and Piccolo, 2014). Transformational leadership was shown to have the highest overall validity (0.44) of the styles (based on 626 correlations from 87 sources) (Judge and Piccolo, 2014), so would certainly explain why the patrol feedback was used so much more effectively to make changes leading to more visits at London Waterloo by a leader showing transformational leadership traits, whereas at Euston no positive change was observed.

Wain and Ariel (2014) discussed the constructs of accountability and surveillance as part of their review of police tracking practices, and theorised that while the additional surveillance of their actions was sometimes seen as undesirable by officers and perceived as excessive micro-management removing patroller discretion, tracking could enhance organisational and personal accountability. It could be the case that the officers and PCSOs at London Waterloo, emboldened by their leader's transformational style, a leader who inspired and motivated them, felt more accountable for their daily patrols and hence responsible for increasing visits when the feedback reports were highlighting poor compliance. Contrariwise, the officers and PCSOs at London Euston may have felt micro-managed and hence defied the direction to increase patrols, which caused the dosage to decrease during the experiment.

What is clear is that the threat of adverse action should patrol dosage fall below par was either 'toothless' (Ariel, 2012) or absent entirely. The Inspector at London Waterloo may have reacted to the feedback showing poor performance for his station and made changes at his station due to his own intrinsic motivation (Oudeyer and Kaplan, 2007) and used his leadership skills to ensure his patrollers changed their behaviours as required. This behaviour cannot be

relied on for every BTP leader. In any change initiative, if there are individuals who will not or cannot change and all has been done to facilitate the change, these individuals must be removed from the organisation (Izatt- White and Saunders, 2014). Skogan (2008) wrote a comprehensive review into why police reforms fail and reported resistance often originated from supervisors and middle managers who perceived change as a challenge to their authority. It is clear that police leaders can 'make or break' any change in policy, which is evidenced by London Waterloo showing such positive change due to the strong leadership, and London Euston taking little to no notice of the feedback with detrimental effect to patrol compliance.

Thus, hands on people management is of utmost importance when trying to increase patrol dosage. It is not sufficient to simply send out negative feedback and expect it to be acted upon by the recipients. Good performance needs to be praised and poor performance needs to be acted upon with real interventions to improve results. Solely telling poor performers their efforts are not good enough and that there will be consequences for continuing as such will get ever worsening results if this threat is never acted upon. People will become complacent because threat of apprehension and risk of sanctioning is perceived not to be present and behaviour will continue on the same poor trajectory.

Future Research

These findings on leadership, based on informal discussion with the leaders and the limited data that could be captured for this study, are limited. This leads to the conclusion that further experiments are required in order to establish with greater certainty the causation path behind the trends observed. What is also clear, however, is that further treatment conditions should be tested in order to determine what *type* of feedback could have the greatest effect. It has been suggested that praise is thought to have more success in changing behaviours, and that deterrence messages do not have a significant effect, at least when applied to tax compliance (Ariel, 2012). This experiment lacked the sophistication to test different methods of managing

people in order to change behaviour: praise versus punishment, surveillance versus accountability, transactional versus transformational. Whilst it is unlikely that all of these treatment conditions could be deployed in a single experiment to allow causality to be explicitly determined between each condition and a change in behaviour, identifying the most effective treatment is definitely in need of further investigation. A further experiment, run as a full Randomised Controlled Trial (RCT) over a longer period of time and deploying two treatment conditions, is what is recommended here.

Limitations of Study

Although this research achieved its aims insofar as the experiment was conducted as planned, there were some quite substantial limitations in terms of the study design. The first major limitation was the study duration, which resulted in a substantially underpowered study. 4 weeks was not an extensive enough time to properly observe the effects. Moreover, as the experiment was classed as Level 4 on the Maryland Scale of Scientific Methods (Sherman *et al*., 1998), selection bias may have been inherently present, affecting the outcomes. Only a full Randomised Controlled Trial (RCT) design would have reduced this threat to internal validity. Therefore, a longer study, planned as a full RCT with a much longer running time, would be required in order to draw solid conclusions and completely accept or reject the null hypothesis.

Additionally, the fact that a number of patrol cards that were tasked out but never made their way back to the Patrol Administrator for their data to be logged and analysed is a sizeable flaw in the design of the study. It means that patrol dosage in reality may have been higher or lower than the percentages calculated in this research, which is a major drawback. Furthermore, there was no control for dosage delivered through means other than hot spot patrol, for instance in a special operation. While this is less of an issue when examining the main research question around patrol feedback, it calls into question the reliability of the correlations observed between

dosage and crime and calls for service, as uniform police officer dosage may have been higher than as recorded through the patrol cards.

Chapter Seven: Recommendations

This chapter will begin by reviewing the policy implications associated with the findings of this experiment, namely the recommendation for further experiment in the form of a full Randomised Controlled Trial (RCT), and summarise the key recommendations to improve the management of hot spot patrol in BTP.

Patrol Feedback Randomised Controlled Trial (RCT)

It was found through this experiment that overall, patrol feedback had no statistically significant effect on patrol dosage. What was interesting, however, was that when the two treatment sites were analysed separately, one site showed no improvement in patrol dosage, yet one showed a remarkable increase upon dissemination of the feedback. It is theorised that this was due to the differing leadership skills and hence the differing actions taken by the Inspectors at the two locations. It is not acceptable to tolerate a position where some leaders will take corrective action to increase the volume of visits, whereas others do not. Performance management of individuals in the latter category is required.

These are nevertheless exploratory conclusions. To confirm these contentions, the primary recommendation for BTP is for a Randomised Controlled Trial with a greater number of treatment and control sites and more importantly, with a greater number of treatment conditions. It has been shown that praise of good performance can be more effective than punishment of mistakes (Kahneman, 2011) and that neither deterrence nor moral persuasion results in significantly increased compliance (Ariel 2012). Therefore, two treatment conditions are being suggested to test these theories in the BTP environment within the context of hot spot patrol feedback. The first treatment condition is one where compliance over a certain threshold receives a congratulatory message from a higher ranked officer (praise condition). The praise aspect could also be bolstered by creating a league table of sites with the highest dosage, so that

individuals can compete to be at the top and feel pride if they achieve it. Secondly, contrary to the first treatment, should be where poor performance receives a critical message from a higher ranked officer (punishment condition). This second treatment condition must be accompanied with a clear plan of action for sites that consistently perform poorly. The consequence of regular poor performance must be made clear to individuals and must be put into action as soon as performance dips to below a certain acceptable threshold so that the threat is not 'toothless'. It has been shown that threats perceived to be 'toothless' (Ariel, 2012) will not be acted upon, so performance will not change. It is not sufficient to keep repeating the same lines around performance being poor and in need of improvement. Clear and swift action must be taken for the threats to be taken seriously.

In terms of running the actual experiment, buy-in is crucial from all levels. Skogan (2008) listed resistance from middle and top level managers as a key reason why police reforms fail. Furthermore, it has been stated that '*a police-led RCT is extremely difficult, but not impossible*' (Drover and Ariel, 2015, p. 95), and that a strong relationship with the officer in overall command of the experiment is crucial. Any Randomised Controlled Trial that takes place must have senior level buy in; somebody willing to step in and take action if it looks as if the experiment is failing. With the punishment treatment option in particular, it may not be palatable to some that individuals performing poorly must be performance managed; the support of a strong commanding officer is therefore indispensable. Additionally, a further two reasons why police reforms fail as listed by Skogan (2008) are resistance by front line supervisors and resistance by front line officers. Middle managers can perceive tracking technology as micro-management which strips them of their autonomy (Wain and Ariel, 2014); they must however continue with the experiment regardless and this must be made absolutely clear from the outset.

BTP has made the decision that the vast majority of their uniform resources will patrol on an evidence based hot spot patrol pattern. A Randomised Controlled Trial will allow BTP to systematically test the best way to ensure this patrol strategy gets delivered each day. A method

of feedback could be chosen and implemented without prior testing with some success; however if BTP is truly embracing Evidence Based Policing (EBP), a thorough test of the best, not just the easiest method of providing feedback, should be determined through experimentation.

Day to Day Patrol Tasking

It has been found that BTP's method of tasking PCs and PCSOs to hot spot patrol by supervisors leaves a lot to be desired in terms of accountability, central oversight and adherence to core hot spot patrol methodology. If BTP is to succeed in becoming an evidence led, hot spot patrolling police force, action must be taken to correct the concerning and somewhat haphazard approach to the tasking of PCs and PCSOs to hot spot patrol by operational supervisors. It is frankly quite concerning that even though the data shows that crime peaks on a late turn, more patrol cards are tasked on an early turn. Furthermore, it is quite bizarre that one week, over 200 patrol cards were tasked out, then a few weeks later only 60 - for no obvious reason. Supervisors must be held to account and challenged to provide reasons why they feel their resources would be better deployed elsewhere on something other than hot spot patrol.

In order to facilitate this, BTP needs to resolve the issue with the actual tracking technologies that will enable this model. The manual tracking carried out for this experiment is not sustainable in the long term for a large number of sites. Tracking must be made a higher priority than it is currently in order for hot spot policing to succeed. Should practices carry on as they have been, supervisors will continue deploying less and less officers to hot spot patrol, and practices will revert back to what they were previously, close to the model described by Berkow as the 'three Rs' – 'random patrol, rapid response, and reactive investigations' (Berkow, 2011, cited by Sherman, 2013, p. 2).

Chapter Eight: Conclusions

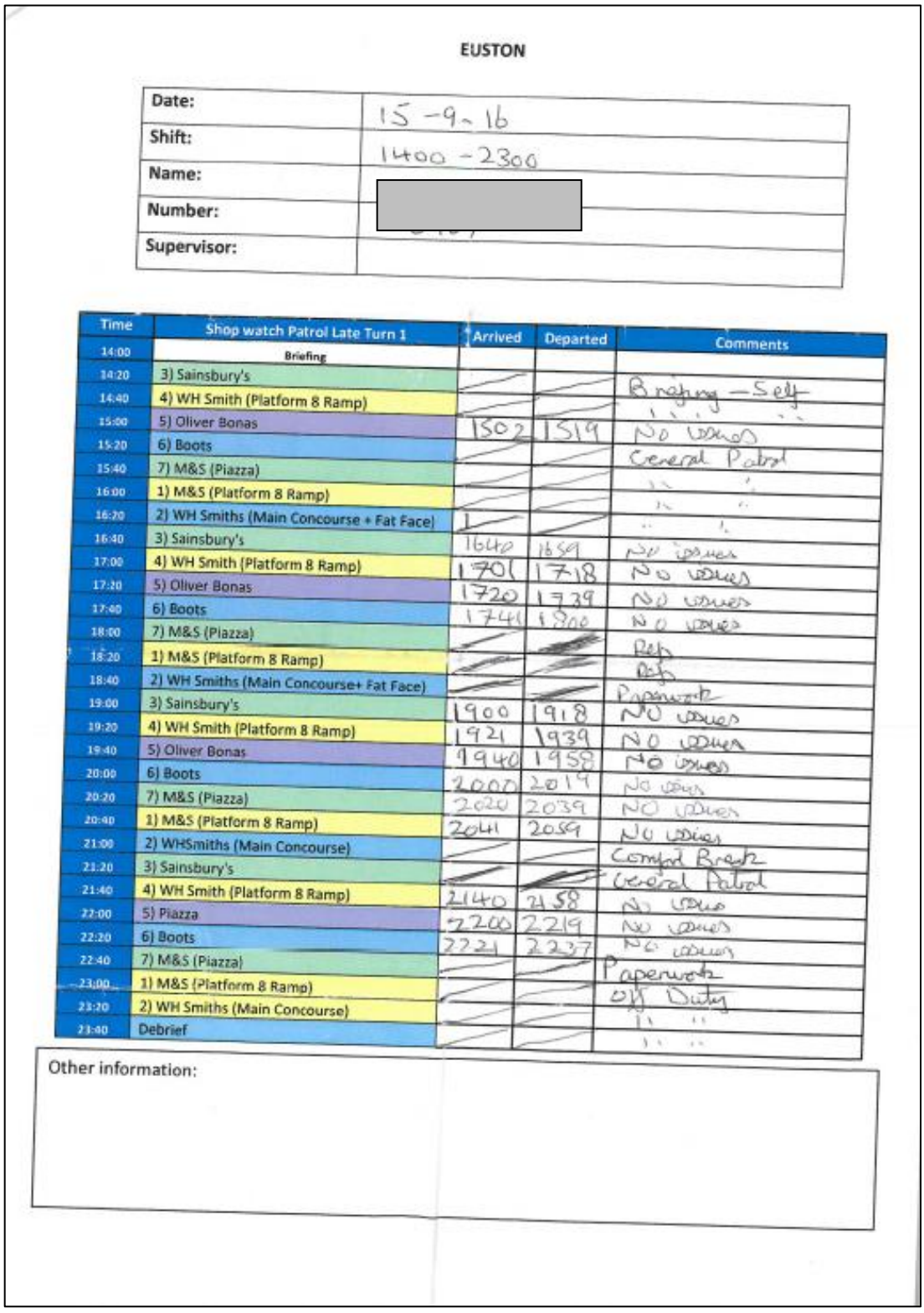
BTP has made great strides in creating a hot spot patrol model using long term crime data in order to drive deployment in a targeted and tested way. Great progress has been made by the project team to begin implementing the model to a work force wary of and resistant to change. However, a substantial amount of work is still required to make BTP one of the front runners when it comes to deploying their Police Constables and Police Community Support Officers in a truly evidence led manner.

The missing link is how to ensure that the PCs and PCSOs tasked with hot spot patrol and the supervisors tasked with tasking the PCs and PCSOs to hot spot patrol all do as they should do day to day. This study identified, albeit with limited power, the potential causal mechanisms that are linked to increased police dosage: leadership and feedback messaging format. Recommendations have been made for the delivery of a future experiment with more experimental units and different feedback styles. In order to deliver this experiment, it is imperative that BTP prioritise the delivery of an automated officer tracking technology system. Without this, while it may be possible to deliver an experiment with the assistance of a vast number of resources and considerable effort through manually tracking hot spot visits and minutes, it would be impossible to put any of the findings into practice as no Chief Constable in the UK would agree to spend their already stretched budget on a team of individuals whose sole responsibility would be to type out patrol returns day in day out.

BTP carried out the UK's first hot spot policing Randomised Controlled Trial, now it is time to return to the cutting edge of research in policing by determining with conclusive evidence exactly how hot spot patrol tracking feedback should be delivered in order to positively influence patrolling to the greatest degree.

Appendices

Appendix 1. Sample Patrol Card



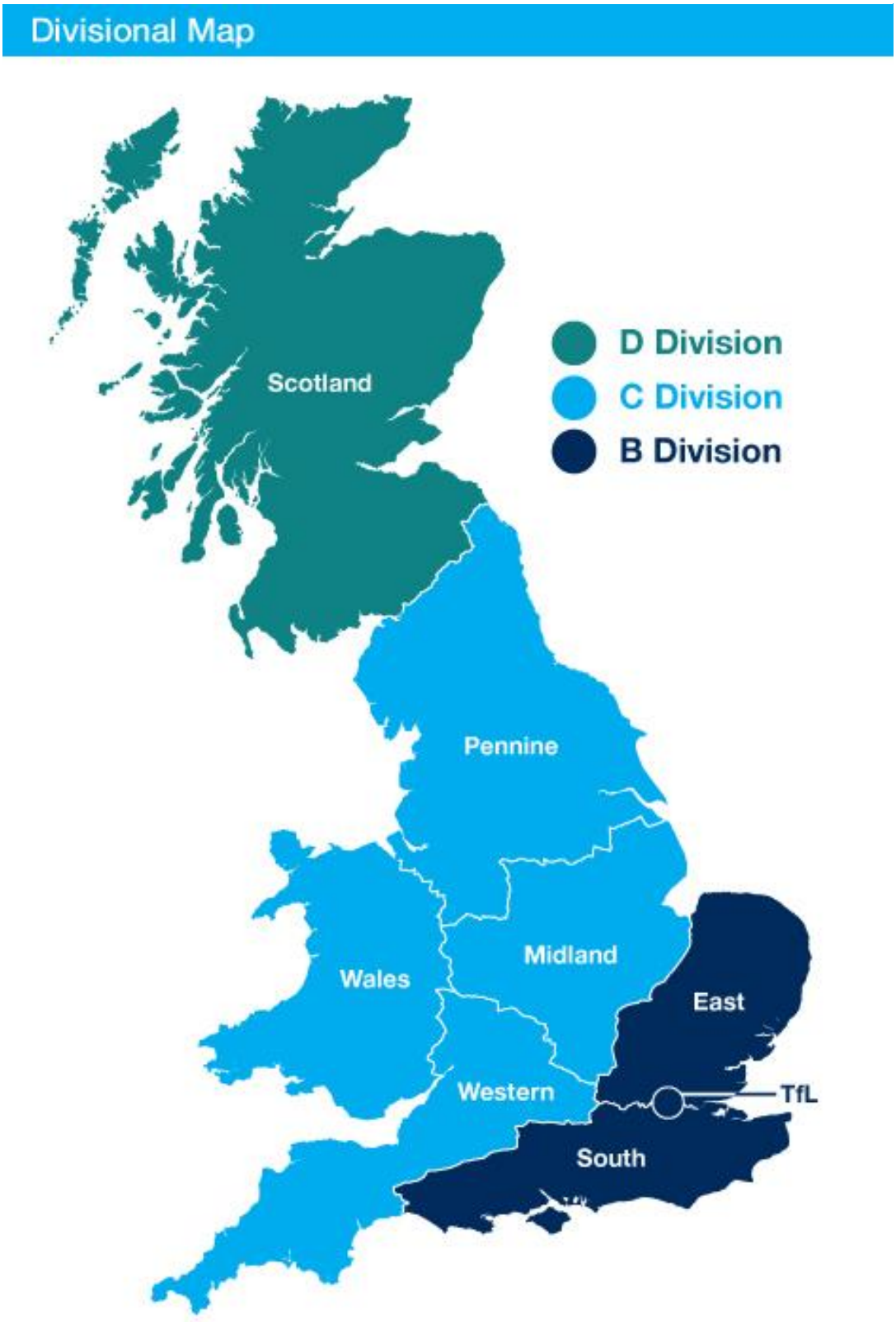
EUSTON

Date:	15-9-16
Shift:	1400 - 2300
Name:	[redacted]
Number:	
Supervisor:	

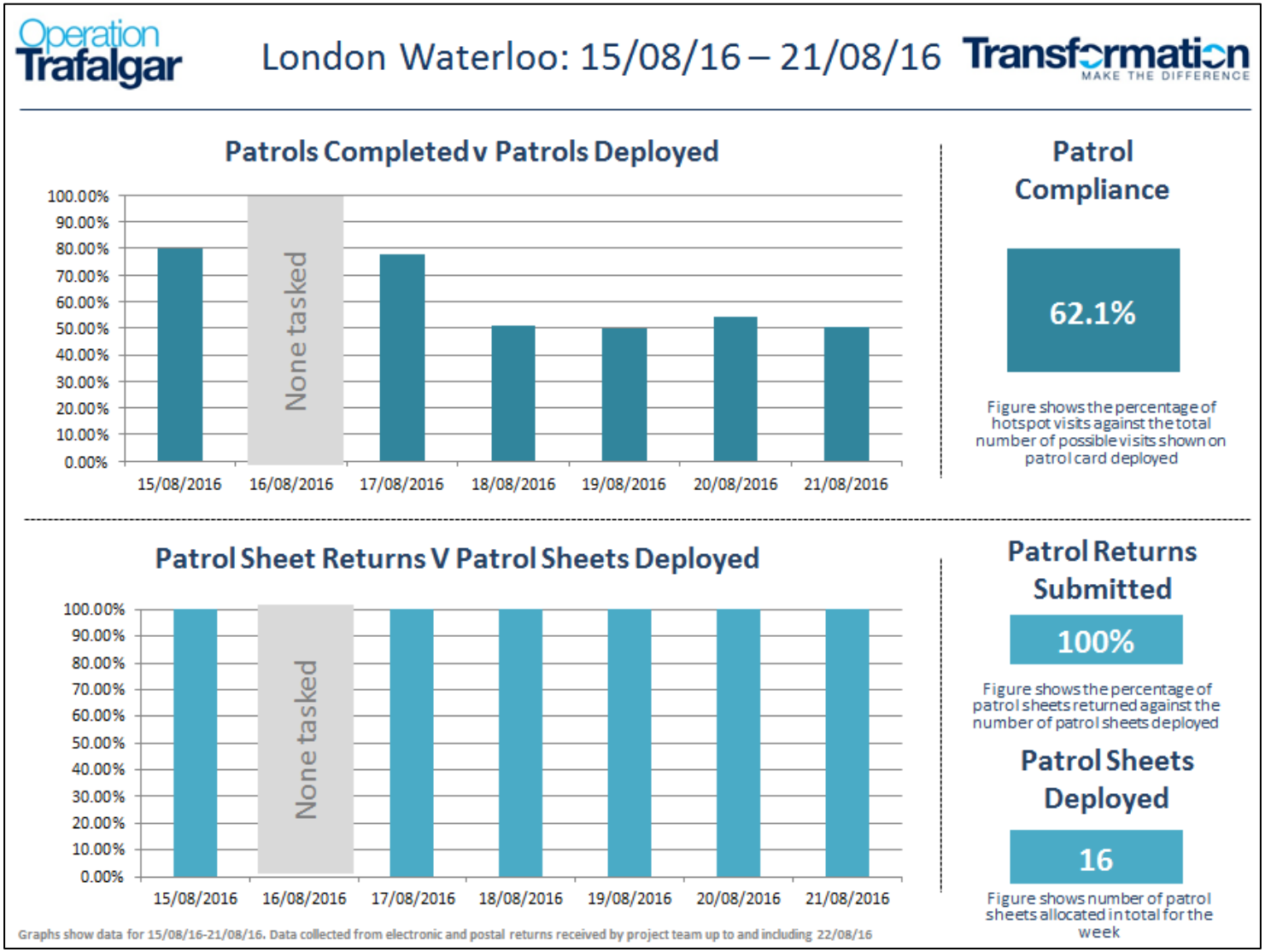
Time	Shop watch Patrol Late Turn 1	Arrived	Departed	Comments
14:00	Briefing			
14:20	3) Sainsbury's			Briefing - Self
14:40	4) WH Smith (Platform 8 Ramp)			
15:00	5) Oliver Bonas	1502	1519	No issues
15:20	6) Boots			General Patrol
15:40	7) M&S (Piazza)			
16:00	1) M&S (Platform 8 Ramp)			
16:20	2) WH Smiths (Main Concourse + Fat Face)			
16:40	3) Sainsbury's	1640	1659	No issues
17:00	4) WH Smith (Platform 8 Ramp)	1701	1718	No issues
17:20	5) Oliver Bonas	1720	1739	No issues
17:40	6) Boots	1741	1800	No issues
18:00	7) M&S (Piazza)			Ref
18:20	1) M&S (Platform 8 Ramp)			Ref
18:40	2) WH Smiths (Main Concourse+ Fat Face)			Paperwork
19:00	3) Sainsbury's	1900	1918	No issues
19:20	4) WH Smith (Platform 8 Ramp)	1921	1939	No issues
19:40	5) Oliver Bonas	1940	1958	No issues
20:00	6) Boots	2000	2019	No issues
20:20	7) M&S (Piazza)	2020	2039	No issues
20:40	1) M&S (Platform 8 Ramp)	2041	2059	No issues
21:00	2) WHSmiths (Main Concourse)			Comfort Break
21:20	3) Sainsbury's			General Patrol
21:40	4) WH Smith (Platform 8 Ramp)	2140	2158	No issues
22:00	5) Piazza	2200	2219	No issues
22:20	6) Boots	2221	2237	No issues
22:40	7) M&S (Piazza)			Paperwork
23:00	1) M&S (Platform 8 Ramp)			Off Duty
23:20	2) WH Smiths (Main Concourse)			" "
23:40	Debrief			" "

Other information:

Appendix 2. British Transport Police (BTP) Map.



Appendix 3. Sample Patrol Feedback Report (London Waterloo).



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