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Thesis Title Targeting Traffic Enforcement with a Collision Harm Index: A Descriptive Study in the City Of London



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<u>Abstract</u>

Years of research has sought to examine the causes for road collisions, their frequency, magnitude and costs to victims, families and to society. Existing literature examines the effects of enforcement on collisions and whether intervention, in its many different guises, can make a difference with collision reduction. Enforcement remains a component part of a three pronged national strategy in the United Kingdom (UK), working hand in glove with engineering and education, all of which are designed to proactively reduce collisions and casualties. This research posits the view that more often than not police agencies respond to events making subjective decisions regarding targeting resources.

Quantitative injury collision data from the City of London Police is analysed, applying a CoLCHI (City of London Collision Harm Index) score to injury events, summed at existing enforcement locations and then ranked. The resultant analysis shows that, despite the best efforts of an increasingly stretched resource, intuitive tasking decisions are common place often missing the areas containing the greatest harm.

Policy makers will need to be cognisant of all available evidence, including harm, in order to target road users at high risk locations, avoiding the immense amount of 'wasted enforcement effort' and continual cycle of response to tragic and arguably preventable events.

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Introduction

This thesis sets out a descriptive study around targeted traffic enforcement and collision harm in the City of London, in order to explore whether evidence of harm has been considered when selecting locations for traffic enforcement. 300,000 people commute into the square mile every day, placing significant pressure on the highways and contributing to inevitable congestion, cited as a factor leading to collisions (Corporation of London 2012). There are between 300 and 400 injury collisions per annum (overall n = 800 injury and non-injury collisions annually) with averages of 50 being serious, including up to 3 fatalities (City of London Police 2013b). Whilst the City is a small geographic area within Greater London, the concentration of motor vehicles and increased use of pedal cycles is at such a high density that collisions inevitably occur (Corporation of London 2012).

The casualty rate for Vulnerable Road Users (VRU's) - defined as cyclists, pedestrians and motorcyclists - is disproportionately high when compared against inner London boroughs (Everett 2013), pedestrians accounting for 26% of all casualties within the City of London set against a figure of 20% for inner London. The cyclist casualty rate is higher again, 28% of the total for the City, compared with 12% for Inner London. This study discusses injury collisions in London and their direct and indirect financial costs, documented by the Department for Transport (DfT) and used within this paper to articulate the extent of the harm caused.

Cyclists have attracted extensive press coverage, following a succession of fatal collisions immediately prior to Christmas 2013 (Myers 2013; Harvey, 2013). The resulting frenzy of media interest focused attention on the extent of the problem and the harm it causes to victims, their families, the health service and other agencies. There is, however, a tendency to kneejerk into enforcement action following such high profile interest, exactly what happened here. Hundreds of police officers were deployed London wide, engaged in 'high profile re-

assurance' at major junctions under the banner of 'Operation Safeway'. This type of activity, whilst probably being inevitable, is certainly unsustainable and doesn't focus activity based on evidence of harm. There is some scepticism that the claims of cyclist casualty reductions under 'Operation Safeway' were wildly unfounded (Road Danger Reduction Forum 2013), demonstrating a problem with drawing any conclusions, particularly success stories, from enforcement campaigns that haven't used an evidence base to define effective targeting.

The Department for Transport introduced a new metric of calculating the harm of road collisions based on the Value in Preventing a Fatality (VPF). Underpinned by a consistent Willingness To Pay (WTP) approach, endorsed by the Home Office (Select Committee on economic affairs 2006; Department for Transport 2012a; Department for Transport 2012b), it includes all aspects of the valuation of casualties comprising human costs, identifying pain, grief and suffering, emergency healthcare, policing, insurance, damage and future lost outputs (Department for Transport 2012). Average values for the prevention of road casualties are assigned combined costs for each element and linked to the appropriate level of severity (slight, serious and fatal). These values are used by this study to define a financial level of harm for each individual collision:

- Slight Injury £14,760
- Serious Injury £191,462
- Fatal Injury £1,703,822

This study cites two criminological theories which underpin the thesis. Firstly Routine Activity Theory (Akers & Sellers 2009; Cohen & Felson 1979; Felson 1998): suggesting its application with a more flexible approach where offenders move about in place and time and where potential collision victims could also be offenders. This suggestion has some resonance when applied to the issue of collisions, considering that 'offenders' may not set out to commit any offences or cause harm. Instead offences (in this case collisions) become more likely as a

result of their underlying behaviour. Deterrence theory is also discussed as a possible premise which may prevent offending behaviour, with this paper discussing the elements primarily for general deterrence (Stafford & Warr 2006; Homel 1988).

In order to answer the question of whether enforcement locations (for operations) have been selected in line with evidence of harm, secondary data- submitted to the Department for Transport by the City of London Police- was analysed, covering 948 City of London injury collision events ranging from April 2010 through to March 2012. The period during the London Olympics was excluded as a result of the extra ordinary policing measures in place at that time. Traffic enforcement data was available for the same period, likewise collected and analysed.

Once the data was cleansed, a City of London Collision Harm Index (CoLCHI) value was awarded to each injury collision record and mapped to each of the 23 enforcement locations currently used for targeted traffic enforcement by the City of London Police (22 being subsequently used for the study). Each location summed the collision harm scores for all events captured within a 200 metre radius of the chosen location on a monthly (and then yearly) basis. Ranking of enforcement locations can then be seen, using the summed CoLCHI scores before being compared with the actual sites where enforcement was delivered. With some fairly compelling results demonstrating that harm was not a factor for targeting decisions

Based on monetary values for harm, set by the DfT (Department for Transport 2012a; Department for Transport 2012b), fatal collisions are 8 times more harmful than serious injuries and 115 times more harmful than slight injury collisions. Meaning that a fatal collision will effectively act as an extreme 'outlier', pushing a location's scoring to exceptionally high levels and potentially skewing a targeting decision if viewed in isolation. A collision harm index formula multiplying time and distance variables is also explored to help establish a more time sensitive harm analysis, in order that events happening more recently carry more importance and weight for tasking decisions; softening some of the extreme spikes evident with the base value only calculation.

This study's approach, using a collision harm index, has indicated that targeting during the period of analysis was not carried out in line with evidence of harm. The comparison between base value, followed by time and distance modelling show that both concentrate on harm scoring; the latter arguably offering a more accurate method to consider the elements of time and distance. The CoLCHI and its application demonstrate that collision events should not be treated equally, and that cognisance of the appropriate evidence should shape decision making in relation to targeting decisions.

Research Question

TFL have set out six clear commitments in order to improve the safety of the Streets of London. Alongside an ambitious 40% overall reduction in KSI rates, there is commitment to tackle road users who put people at risk, by way of enforcement (Transport for London, 2014). This issue has been pivotal, developing research questions for this thesis, in order to ensure both social importance and scientific relevance (Bachman & Schutt 2010, p.38), the former because the findings may help to shape public policy, preventing death and injury, and the latter because there appears to be a gap in relation to research involving traffic enforcement programmes in central London, specifically the City of London.

The research question:

"Have enforcement locations (for operations) been selected in line with evidence of harm?"

Literature Review

Introduction

This literature review explores the extent and context of police traffic enforcement and injury collisions, examining both government papers and reports alongside empirical research. The problem is manifest worldwide, with an estimated 1.2 million people being fatally injured annually as result of traffic collisions. A further 50 million are estimated to be injured in collisions globally (World Health Organisation 2004), and whilst the demographic of some nations, notably third world countries, is not directly comparable to the UK, context for the United Kingdom (UK) is important.

This section examines national, regional and local figures for collisions, reviewing recent reductions in their numbers alongside predictions for the future. It may be helpful at this stage to explain that this study refers to 'collisions' as opposed to 'accidents': a commonly used parlance, because these events do not happen 'by accident' suggesting there will always be a contributory factor for the coming together of road users (Crown Prosecution Service 2014). Collisions are classified into three categories, described as slight, serious and fatal, with the extent of the casualties' injuries dictating the relevant grouping. The reporting itself is completed by the police using the information available at or shortly after the collision (UK Government 2012):

- Slight Injuries are defined as sprains bruises or cuts, generally not necessitating medical treatment
- 2. Serious Injuries will include severe cuts, fractures, burns, concussion and other injuries which would require medical treatment at hospital as an "in patient"
- 3. Fatal Injuries speak for themselves, but a fatal collision is one involving at least one fatality

Once the collisions are reported, the harm inflicted to the road user can be calculated and this chapter examines the extent of that harm, reviewing the Cambridge Crime Harm Index (CHI) (Sherman et al 2013) and whether its basis for weighting incidents based upon a numeric base value can be applied to test traffic enforcement locations. This chapter explores whether the Department for Transport (DfT) baseline casualty figures, assigning a monetary value to the three levels of injury, might serve as the basis for a City of London Collision Harm Index (CoLCHI).

Collisions and the Vulnerable Road User. Extent of the problem

The DfT annual statistics demonstrate the extent of the problem for collisions and road deaths nationally, articulating that the UK has around 1,700 deaths per annum resulting from traffic collisions (Department for Transport 2014). Whilst the numbers have reduced, indeed they have been cut by half since 2000 (Department for Transport 2014a), the latest figures actually show a 3% rise with fatal collisions nationally (Department for Transport 2014b). Serious Injury collisions, generally necessitating hospital treatment as an 'in patient', likewise have reduced dramatically nationally since 2000, falling by 43% (Department for Transport 2014). Whilst the overall numbers of casualties have reduced in the City of London over the same period; down from 458 in 2000 to 409 in 2011 (Everett 2013), those seriously injured in the City have seen recent increases (Rickwood 2014).

The worrying headline here, sees a disproportionate number of vulnerable road users (VRUs) being injured, when compared against other inner London boroughs. Vulnerable road users (VRUs) are described as being pedal cyclists, pedestrians and motorcyclists (Transport for London 2012a; Rickwood 2014); reported in 2013 as being as high as 79% of the overall

injury totals for that year (Everett 2013; City of London Police 2013a; City of London Police 2013b). Pedestrians account for 26% of all casualties within the City of London, set against a figure of 20% for inner London. The cyclist casualty rate is higher again at 28% of the total for the City, compared with 12% for Inner London (Everett 2013).

There is recognition on an International scale for VRUs, with the problem in lower income counties appearing to be much worse: "because of the variety and intensity of traffic mix and the lack of separation from other road users" (World Health Organisation 2004, p.41). According to the European Transport Safety Council, the risk of death for every 100 million kilometres travelled is 13.8 for two wheelers, 6.4 for pedestrians and 5.4 for cyclists in Europe. Compare this to the figure of 0.7 for motor cars and 0.07 for buses and coaches (World Health Organisation, 2004) and the problem is fairly clear, replicated and supported by recent reports in the City of London.

This thesis is interested, amongst other things, in the movement and flow of road users, notably VRU's, in the City of London. It will signpost the extent of the problem London wide, noting that the City of London only accounts for 1% (n=380) of all casualties in Greater London, using 2010 figures, (Stansfield et al. 2012) and whilst some of the travelling trends appear to be similar for London as a whole, the City of London has a disproportionate number of VRU casualties (Everett 2013; Rickwood 2014).

Decisions around traffic enforcement sites, along with the density and frequency of activity is currently driven quantitatively and intuitively, where intervention is introduced either because of sheer volume, or headline grabbing events. The autumn of 2013 saw an immense amount of effort being expended with traffic enforcement across London as a whole, following half the annual London count of cyclist fatalities (n=6) occurring in just two weeks. The adverse headlines prompted a so called 'police crackdown' in the run up to the festive

season, under the banner of 'Operation Safeway'. Whilst the subsequent casualty reduction was welcomed and celebrated by the Mayor of London (Greater London Authority 2014), some commentators were sceptical of its success, questioning the effectiveness of the enforcement (Road Danger Reduction Forum, 2013; Sutton 2014; Payne 2014; London Cycling Campaign, 2014) and its focus on relatively minor traffic infringements by cyclists.

The City of London Local Implementation Plan (LIP) contains proposals to increase both pedestrian and cyclist numbers (10% and 46% respectively) in the City (Stansfield et al. 2012; Corporation of London 2012; Everett 2013). These increases, if realised, will present weighty challenges, as the area already sees overcrowding of footways and narrow streets at peak times. There is, however, a school of thought that collision rates could actually decrease at specific intersections where there are increases in people walking or cycling; apparently brought about by self-regulation and adjustment by motorists linked to the prevailing conditions (Jacobsen, 2003).

The increase in cycling numbers is supported by DfT statistics which show a threefold increase in cyclist movements, tracked over 39 points in the City, since 2000 (DfT, 2013). This increase contrasts with reductions in car and motorcycle movements, conversely seeing increases in buses and coaches and a small reduction in Heavy Goods Vehicles (HGVs). There will always, however, be spikes which are linked to periods of greater demand: for example, the last year has seen an increased volume of HGVs, linked to the Pan London Cross rail development, using the City streets(Buck 2014).

HGVs were examined as part of a British study into cyclist collisions in 2009, examining 430 fatal cyclist collisions occurring between 2005 and 2007. That particular study concludes that 18% of these fatalities (n=78) were involved in a collision with an HGV (Knowles et al, 2009). Whilst this figure is lower than the 50% stemming from collisions with cars (n=215), it

appears to be a disproportionate number of fatalities, considering the lower number of HGVs on Britain's' roads when compared to cars (Knowles et al. 2009). This assertion is supported in London by a study for TFL in 2012, examining 197 fatal pedestrian collisions showing that 14% of cyclist collisions (n=27) involved HGV's (Knowles et al. 2012, p.19).

Whilst these examples relate to a small number of incidents, collisions between HGVs and vulnerable road users are far more harmful than nearly all other forms of traffic collisions (Knowles et al. 2009, p.vii; Knowles et al. 2012); meaning that these vulnerable road users are more likely to be killed when in collision with an HGV. There are well documented contributory factors for these collisions involving pedestrians and cyclists, and inattention, for all of these road users, is well cited as a primary reason (Knowles et al. 2009; Knowles et al. 2012; World Health Organisation 2013).

STATS 19 is the name of a form used by all police agencies in the UK, to report injury collision data for collation by the DfT. Police Officers input a number of variables recorded for each collision, including contributory factor data. The data are generally submitted after the event and usually very subjective, suggesting an intuitive rather than a deliberate careful assessment of hard facts. This intuitive approach probably seems the most logical application, given a traffic police officers' subject matter expertise. Arguably engendering stereotypical lazy conclusions, based on known existing patterns rather than a logical assessment of all the facts which may throw up different explanations (Kahneman 2011). This is in addition to the problem faced by underreporting, where non- fatal pedestrian and cyclist injuries may be vastly underestimated (World Health Organisation 2004), particularly if injury or severity could not be established at the scene of collisions or indeed the collision itself was not reported (Tranter & McGrath 2007).

Forecasting, Placing a Value on Collisions and Casualties

Rigorous forecasting around the reductions we could expect to see by the year 2030 (Mitchell & Allsop 2014), posits the suggestion that the national headline fatal collision figure could reduce by 44% (750). This reduction is based on the examination of previous years' statistics and likely trends. The Mitchell and Allsop study re-enforces the importance of forecasting. Firstly to target those road users who will need extra effort in order to reduce casualties, predominantly VRUs, secondly to highlight the spending required over the course of time, and thirdly to post targets which are based on evidence and challenging. Even if we accept confidence with this forecasting and celebrate the apparent good news, the reality remains that there will still be a third of a million Killed or Seriously Injured (KSI) casualties between now and 2030, with a prevention value of £110 billion (Mitchell & Allsop 2014, p.3).

The financial figures used in the Mitchell and Allsop report have been developed by the DfT, who have introduced a Value in Preventing a Fatality (VPF), derived from a Risk Cost Benefit Analysis, underpinned with a consistent willingness to pay approach supported by the Home Office (Select Committee on economic affairs 2006; Department for Transport 2012a; Department for Transport 2012b).

Values are calculated for the three categories of slight, serious and fatal injuries, comprising loss of output, emergency services, coupled with hospital and human costs. The latter based on amounts people say they would be willing to pay to prevent the collisions from happening; which would include the avoidance of grief, suffering and pain for the victim, their family and friends as well as the loss of life enjoyment. The amounts are set out in Table 1, which shows the costs of individual casualties, along with costs 'per accident'. These amounts will form the 'base value' for the City of London Collision Harm Index (CoLCHI). The costs per 'accident' have been averaged out taking into consideration a number of collisions that will

have multiple casualties. The CoLCHI uses the cost 'per casualty' figures, as the vast majority of City of London injury collisions involve single casualties.

Accident/casualty type	Cost per casualty	Cost per accident
		£2012
Fatal	1,703,822	1,917,766
Serious	191,462	219,043
Slight	14,760	23,336
Average for all severities	50,698	72,739
Damage Only		2048

TABLE 1 VALUATION OF INJURY ACCIDENT PREVENTION

Source: Department for Transport (2012b)

The Parliamentary Advisory Council for Transport Safety (PACTS) and DfT have used these figures to calculate the total cost of prevention of road casualties and accidents (collisions), PACTS to forecast the projected numbers of casualties in 2030, and the DfT to provide yearly prevention values based on reported collision data (Mitchell & Allsop 2014; Department for Transport 2012a; Department for Transport 2012b). The forecasting is particularly important for the City of London Police, as it receives £1.2 million per annum from TFL, in order to deliver traffic enforcement. This figure should be compared to the value placed upon preventing injury collisions, and this study will also argue that it needs to be compared with the CoLCHI enforcement location scores. There are manifold reasons why collisions happen in the first place, including driver behaviour, vehicle construction, weather, speed, road layout and traffic density to name but a few. Driver behaviour and the environment can play an enormous part in defining where, when and how collisions take place, so it is right to highlight that whilst this study is looking at the issues surrounding enforcement, we shouldn't forget the important part played by other areas. In London the current TFL action plan references activity to be carried out across all of the three 'e's' of enforcement education and engineering (Transport for London 2014d; Transport for London 2014b; Transport for London 2014c; Department for Transport 2011). Whilst the City of London Police is committed to work across all three areas, this study concentrates on the specific area of traffic enforcement.

Collision Harm

Levi (1997) articulates the understandable focus placed on those killed as a result of careless or dangerous driving, despite the far greater numbers of citizens killed as a result of collisions during every day business. This particular issue is specifically examined for this study, where the paper suggests that those killed or seriously injured represent substantial harm for themselves, family and friends, regardless of whether it was the result of a criminal act. Whilst the numbers of injury collisions in the City of London may seem quite small, there would be substantial preventative costs attached to them, if the DfT casualty valuation figures were apportioned (Department for Transport, 2012b). If these costs were applied to the 2013 City of London injury collision figures, they would amount to:

- $300 \text{ (slight) } \text{x } \pounds 14,760 = \pounds 4,428,000$
- 50 (serious) x \pounds 191,462 = \pounds 9,573,100
- 3 (fatal) x \pounds 1,703,802 = \pounds 5,111,466

=£19,112,566

TFL provide £1.2 million per annum for the City of London Police to deliver enforcement activity to help prevent injury collisions. This funding represents only 6.2% of the total preventative costs, illustrated above, using the raw base values provided by the DfT. These raw values, as illustrated, don't take into consideration the spread of harm linked to specific locations, as it merely sets out the overall sum, without an indication as to where the harm is greatest. The process of summing collisions at specific relevant sites should also be undertaken in order to inform and ensure specific targeted enforcement activity is focused.

The development of the Cambridge Crime Harm Index (CHI), by Sherman et al, has provided some thought and direction as to whether the same principles could and should be applied to injury collision harm. A simple count of collisions on their own could be a very misleading statistic, particularly if an overall numeric rise or fall is lauded as a success, without reference to the context surrounding incidents involving the most harm, and especially where these incidents have remained the same or increased within the overall headline figure (Sherman et al, 2013). Sherman et als' paper describes how high volume minor crimes hold a disproportionate amount of weight within the overall crime counts; the same could be argued for the large number of slight injury collisions which seemingly drive targeting decisions for traffic enforcement.

The CHI proposes that each reported crime is multiplied by the amount of prison days that a previously un-convicted offender could expect to receive upon sentencing. This approach would see far greater scores for increased harm, lower instance offences of murder and rape for example (Sherman et al. 2013). In turn, this could influence targeted police activity (and funding for the same), based on concentrating effort and scarce resources to where the greatest harm is present. "Targeting and Testing require highly reliable measures of crime and harm" (Sherman 2013, p.384). It would therefore seem reasonable to apply these principles to injury collisions, in order to target funded City of London Police assets to the areas where the evidence tells us the greatest harm exists. Collisions have been assessed by TFL, analysing data from the STATS 19 database, resulting in information being made available including collision type, classification of road user as well as location analysis, resulting in a more risk based approach to future preventative work (Transport for London 2014d, p.24,26). This approach, as a minimum, will be helpful if TFL are to achieve anything like the "40 per cent reduction in KSI casualties by 2020, from a baseline of the 2005-2009 average" (Transport for London 2014d, p.29). What appear to be missing from the literature reviewed thus far are calculations of harm associated and attributable to geographic locations.

The City of London Police, like their Metropolitan neighbours, receives funding from TFL in order to deliver a range of activity, primarily against the education and enforcement strands of their action plan. Outputs, such as penalty notices, arrests, vehicle seizures and reports for issue of summons, are recorded and submitted to TFL, but there is currently no causal analysis carried out comparing enforcement operations alongside the City of London collision data. This means that if the collision rates drop, as they have in the City over the last couple of years (City of London Police 2013b; City of London Police 2013c) there could be an inaccurate assumption that the drop has been attributable to the levels of enforcement. There is no evidence to support this claim.

A decade ago TFL commissioned a systematic review (Broughton & Elliott 2004), looking at how methods and levels of enforcement affect road casualty rates. Within which is an early assumption that if no enforcement is delivered, then collision rates are expected to be at their highest (Broughton & Elliott 2004). They summarise that an introduction of enforcement activity doesn't net any tangible results until drivers are aware of policing presence and adjust their driving accordingly. This suggestion will only be effective to a certain point before any deterrence will start to decay. Both Rothengatter and Kahneman caution that any reductions should always be analysed, taking into account the rate of collisions before the enforcement started (Kahneman 2011, p.424; Rothengatter 1982, p.350). Any above average collision area may see reductions as a result of regression to the mean, where spurious explanations provide 'reasons' for success as suggested earlier with the Metropolitan Police 'Operation Safeway'.

Meta-analysis carried out and cited in another study by Elvik, suggests that collisions are reduced with a physical police presence (Elvik 2001, pp.13–19) recording reductions up to an impressive 45% in fatality reduction where red light enforcement cameras were deployed. If these percentages were applied to the harm values set by the DfT for injuries sustained in collisions, and multiplied by the number of collisions that were prevented, it is clear that big savings could be made.

Another aspect of police traffic enforcement concerns the focus on locations *and* types of offences to be targeted. Elvik (2001) goes on to say that Norway has historically delivered enforcement at selected locations, essentially only because they always have. The locations may have previously featured as being particularly busy for violations and collisions (Elvik 2001, p.62) and this approach was institutionalised. This behaviour has resonance in the City of London, where largely intuitive responses have seen the selection of a fairly small number of repeatedly used enforcement sites. Elvik has listed the Norwegian traffic violations which research has shown to be the major contributory factor with fatal collisions, with a proposal that Police agencies target their planned enforcement on those issues (Elvik 2001). Whilst the Norwegian approach may be eminently sensible in a large geographical area where there could be a delineation of offending, district to district, it may not be practical in the City of London, a small densely packed area where violations such as speed and intoxication are rarely factors with injury collisions.

There appears to be a link between risky driving, breaking traffic law and collisions (Parker et al. 1995), and offending type is underlined again in a Israeli study where speeding, driving under the influence of drink and drugs, failure to wear seat belts and running red lights are all cited as having "significant associations with the prevalence and severity of crashes"

(Factor 2014, p.87). The London context is important for this study, as road user behaviour is markedly different between busy urban areas and rural locations (Broughton & Elliott, 2004). Previous studies examining enforcement and collision reduction will not necessarily be 'generalisable' and consequently applicable to the City of London. Specific relevance is important for this thesis; hence any studies carried out in the London area are of interest.

Research undertaken in South London (Walter et al, 2011), looked at the effects of increased enforcement along the A23 in Croydon. That study followed previous work completed for the Transport Research Laboratory (Broughton & Elliott, 2004), the former broadly concluding that enforcement did see improvements with driver compliance and subsequent casualty reduction. The 2011 study saw a large volume of vehicles stopped, with the police issuing a high number of fixed penalty notices. Interestingly there would also appear to have a been a 'halo' effect in surrounding areas, where the more serious road traffic offences were reduced, possibly as a result of the sustained interventions over a four week period (Walter et al. 2011). This finding is useful to consider for any enforcement location where diffusion of benefits, resulting in collision reductions, would be welcomed.

Davey and Freeman (2011) suggest that layered approaches using a number of varying components are the best method to alter driving behaviour rather than rely on single solutions in isolation, such as speed cameras. Well publicised road safety campaigns, education, and enforcement, automatic solutions could all arguably see some deterrence from driving behaviour which either leads to collisions or is unlawful per se. The challenge involves coordination of the most appropriate component parts which can maximise deterrent effects: underpinned by an evidence based carefully targeted approach to "increase the likelihood of identifying and apprehending motorists engaging illegal behaviours" (Davey & Freeman 2011, p.34).

Data driven approaches to crime, congestion and traffic safety (DDACCTS) is a new approach for TFL, imported from the United States, involving robust data collection,

evaluation, management and response (Bruce, 2013). The initiative concentrates on outcomes and an ability to deliver successful outcomes across manifold problem areas, such as crime, collisions and congestion; effectively single tasking in problem areas dealing with multiple problems with the same activity.

The ability to synthesise analytical products in order to brigade responses to social harms is of particular interest for this study, where a targeted response to the areas of highest risk could reduce serious injuries from collisions, whilst also delivering multiple outcomes for other problems, using the same resource expenditure (U.S. Department of Justice 2012). This approach could reap benefit for the City of London where policing problems are often overlaid across multiple locations. The DDACCTS approach could see multiple crime and road safety issues being addressed at the same location with no discernible difference in the intervention itself, but potentially deterring criminal behaviour across multiple problem areas. Deterrence from one course of offending would be welcomed, but it would appear that this may be possible for many, and welcomed by any public body facing cuts in spending, where intelligent choices around enforcement will be essential for the future.

Criminological Theory

Deterrence Theory

This study examines the effect of traffic interventions upon collision reduction, thereby suggesting that road users who break the law, as a component part of their driving, would refrain from it when presented with the risk, or direct prospect, of legal punishment. When the efficacy of road safety intervention is considered, its effect on deterring road users from engaging in illegal behaviour should be nailed down to perceptions about certainty, severity and celerity of sanctions (Davey & Freeman 2011). The area of road safety depends heavily upon altered behaviour resulting from the perceived threats of being caught and being punished quickly (Homel 1988; Davey & Freeman 2011). Homels' work in relation to random breath testing (Homel 1988) mentions the value of both formal and informal sanctions. The latter suggesting a driver could be socially stigmatised, potentially just as effective as a drink drive ban. On the basis that cultural and social norms can affect societal behaviour, informal non-legal sanctions could actually be just as powerful if not more so, than the formal legal factors (Von Hirsch et al. 1999).

This suggestion is in contrast to the apparent lack of deterrence demonstrated by some road users for offences which are not seen as serious, or are so widespread that they are almost accepted as the social norm. One such offence is the use of mobile phones whilst driving. The law in the UK changed in 2007, introducing penalty points and a £60 fine for the offence, which saw a big drop in offending. Since then, offending has slowly risen again (Novis 2010), this fact was noted by the Walter et al (2011) study in South London, prior to commencement of their study, examining the effects of 'Operation Radar', a four week intensive traffic enforcement operation. The operation hardly noticed any reduction in mobile phone offending

(or indeed seat belt infringements) during a prolonged enforcement campaign which saw some marked reductions in speeding offences. 'Operation Radar' was well publicised, with some noticeable effects, but it would appear that driving behaviour didn't alter for the more minor offences. This point has resonance for the City of London where regular enforcement activity routinely targets the more minor offences. If planned campaigns in the future aim to target the less serious infringements, altered driver behaviour and subsequent collision reduction may not live up to the aspirations of policy makers.

Deterrence can be separated into the general and specific forms, the former relating to the treatment of the public at large, the latter relating to the impact of penalties on those who have endured them (Homel 1988). The question for the City of London is whether general deterrence by virtue of overarching statute and laws can prevent offending, or whether continued targeted enforcement with severe penalties has contributed towards any casualty reduction by way of specific deterrence. It could be argued of course that a person may be predisposed to certain behaviour which leads to collisions occurring, but additionally as a result of their own direct and indirect experience with punishment (Stafford & Warr, 2006), in this case road traffic sanctions. This study does not have any data in relation to driver behaviour, post-intervention, hence whilst it remains an important point, it cannot be explored further in this thesis.

Drivers, particularly speeding drivers, often do so regarding offending as an 'occupational hazard', without any real comprehension of the risks of being caught and punished or the risks in causing or being involved with collisions (Scottish Office Central Research Unit 1997). The Scottish study goes on to set out where confusion lies over permissible levels of alcohol, belief that speed limits will only be enforced when a driver is a certain percentage above the limit and confusion around the reasons for setting speed limits at particular locations. This paper has already cited the importance of layering intervention

activity, including publicity and media as important component parts of successful targeting, and this point is underlined in the Scottish paper, recommending a "range of complementary measures to promote road safety" (Scottish Office Central Research Unit 1997, p.ix).

Transport for London alongside the City of London Corporation have recently undertaken an extensive publicity campaign in the City, introducing a new 20mph speed limit, to deter road users from unlawful excessive speeding. This statutory provision coupled with the 'Stop, Think, Live campaign' has sought to ensure that the issue is at the forefront of road users minds, by explaining the offence and setting out the penalties for infringements, before they even start a journey (City of London Corporation 2014). The purpose being to drive home the message that offending behaviour will be dealt with swiftly. An interesting take around this idea has been explored in China where traffic infringements are stored against a drivers details, only becoming punishable when the vehicle is taken in for annual checks (Lu et al. 2012). A randomised control trial saw traffic violations drop by 14% in the treatment group when offenders received a text regarding their traffic violations, the analysis supporting the notion that offending behaviour can change if the transgressors are aware of it.

Routine Activity Theory

Offending behaviour can lead to the commission of crime when accompanied by suitable targets and in the absence of capable guardianship (Cohen & Felson 1979), these crimes could easily contribute towards collisions, highlighting those ending with serious or fatal injuries. Routine activity theory requires three necessary conditions to be in place in order for a crime to be commissioned (Akers & Sellers 2009; Cohen & Felson 1979). The theory is reliant upon the convergence of a motivated offender, a suitable target or victim along with the absence of capable guardians of persons or property. One may assume that these component parts would sit together exclusively in matters relating to conventional crime, but it could be

suggested that the theory will equally apply to traffic collisions, where motivated offenders could also be victims.

Traffic collisions occur when motivated offenders are present at locations with victims, without suitable guardianship. It could also be argued that this issue is more complex than explained by Akers and sellers (2009), whereby collision locations are different and offenders could also become victims. It would also seem reasonable that both are dependent upon formal and informal guardianship (Coupe, 2013). The former utilising the police, traffic enforcement officers and local authorities in a position to prevent an offence or collision taking place, the latter arguably including traffic calming, lighting, other road users, neighbours, family, teachers and other organisations that may have a part to play with guardianship. Haulage and bus companies could also feature here due to the critical part they can play preventing cyclist casualties by driver education, better mirrors, signage and minimum safety standards (Transport for London 2014a). Potential Offenders may not be actively seeking a collision, but could be pre-disposed to behaviour which would make it more probable. Police traffic campaigns should recognise this fact when targeting road users who could slip into bad driving behaviour more easily. Much in the same way that a burglar does not wear a stripy t shirt and mask, potential traffic offenders may not be so obvious.

The importance of location and offender behaviour will have an impact upon the convergence of activity of both victim and offender. This should include evidence relating to harm, with enforcement locations and injury collisions. Felson has suggested that the theory now goes far beyond direct predatory crimes (Felson, 1998), so to contextualise this complex area expanding its use from its original principles would seem appropriate.

The driver could be a motivated offender, meaning he is consciously speeding, driving whilst impaired, uninsured or driving a dangerous vehicle. He would be aided by traffic violations such as improper lane changes, failing to stop, failing to look and infringements of protocols such as maintaining speed limits. Riskier behaviour could be fuelled by impairment, tiredness, inattention, complacency or bad habits. Likewise this could also extend to vulnerable road users: the pedestrian failing to look, stepping out from behind parked vehicles, jaywalking or texting; or the Cyclist who doesn't obey the same law as other road users by shooting through red lights, failing to signal, cycling on the pavement and failing to wear high visibility clothing. Conversely, all three could also switch to become suitable targets or victims, particularly the latter two who would be more vulnerable than drivers of motor vehicles in this particular urban setting.

Research Methods

Introduction

The method for the research is descriptive analysis. In order to answer the question of whether enforcement locations (for operations) have been selected in line with evidence of harm, secondary data was obtained from existing sources to explore any relationship between targeted enforcement activity and collision harm. The bulk of the data in relation to injury collisions was available through the STATS 19 information, submitted to the DfT by the City of London Police.

Collision data was collected, ranging from April 2010 through to March 2012, with a sample size of n=948 separate collisions. Enforcement data for the same time frame was available and has been collected. There are no ethical reasons why the information could not be collected and analysed. Once the data was cleansed and re-arranged; a City of London Collision Harm Index (CoLCHI) score was attributed to each collision record and mapped to each of the 22 enforcement locations, using a geo location tool within the ESRI mapping system, where the sum of the collision harm was calculated for a 200 metre zone around each enforcement site. It was then possible to map collision harm by location and by financial year, using the year totals to rank the enforcement sites in descending order of CoLCHI, and comparing them with enforcement locations that were selected for policing activity.

The initial round of CoLCHI scoring was completed by attributing the base value cost for a collision (as set by the DfT and agreed by Government), by severity type, to the relevant collision, and then summing the total for all collisions within a 200 metre radius of the centre of the enforcement site. This initial analysis, whilst attributing a 'harm' score to the collision, didn't take into account how long ago the incident happened. This study seeks to test whether current targeting practices are placing police resources in the right place to prevent collisions from occurring. The temporal considerations, in particular, are a concern, because fatal collisions attract a very high score: 8 times more harmful than collisions which cause serious injury and 115 times more harmful than slight injury collisions. If no allowance is made in relation to when a fatal collision occurred, a location could be shown as 'red' or 'hot' for some time, which in turn could skew a targeting decision.

Given the concerns regarding the time factor, a further round of analysis was undertaken using the relevant DfT base value for a collision, multiplied by time and distance variables, to establish a more accurate and time sensitive harm analysis. This proximal collision harm index approach looks back 12 months from a control month of April 2011, to compare the sites selected for enforcement against those with the greatest proximal CoLCHI score. For example two fatal collisions occurring in the last fortnight, should probably influence a targeting decision tomorrow, while those which happened eleven months ago should be weighted differently. The new time and distance calculated figures reflect the harm of the collision in relation to its geographical distance from the centre of an enforcement location and in relation to how long ago the collision occurred, before enforcement started at that relevant site.

The CoLCHI approach, firstly using base values in isolation, then base values multiplied by time and distance variables, has allowed the study to signpost whether current targeting was carried out in line with evidence of harm. The comparison between base value calculations only, followed by time and distance modelling has been useful to demonstrate that both concentrate on harm scoring; the latter arguably offers a more accurate method with which to consider the elements of time and distance

City of London

The City of London is the most historic part of London, established in around AD50. It remains the world's leading financial centre with office workers outnumbering residents by 33 times. The residential population currently numbers a little under 10,000, with over 300,000 people coming into the City of London each day to work. Despite being only 1.1 square miles, the City is served by 48 miles of road, which is tightly packed into a street system which has changed little, in terms of size and layout, in hundreds of years. This ancient City presents challenges when faced with a huge influx of vehicular and pedestrian traffic each day, co habiting a limited space. Vehicle flow has reduced a little over the last five years in the City of London but the current figures confirm over 62 million motor vehicle movements per annum in the square mile and nearly 7 million pedal cycle movements (Department for Transport 2013b).

Collision reporting

All injury collisions are required by law to be reported to the Police (Anon 1988) under section 170 of the Road Traffic Act 1988. Practically, this reporting can either be carried out at the scene of a collision, by a police officer, or to a Constable at a police Station within 24 hours. The Standing Committee on Road Accident Statistics (SCRAS) provides the governance for data collection nationally in the UK, overseeing the information recorded on the STATS 19 forms related to injury collisions. There are benefits with a common national standard, allowing government bodies such as the DfT to prepare statistics and carry out research into road safety matters. It additionally provides a tool for the police to inform tasking decisions assisting with collision reduction targeting (Administrative Data Liaison Service 2014). The system is not perfect and relies on accurate inputting of data, coupled with an objective view. In general terms information stored *directly* by the relevant agency, in this case the STATS 19 data submitted to the DfT by the City of London Police, will be higher in quality than peripheral items (Robson 2011, p.361), however potential recording errors needed to be assessed during data cleansing process.

The City of London Police will normally attend all reported injury collisions in their jurisdiction. Police officers complete a collision report booklet, an example of which is shown at *appendix A*. This booklet is the first port of call for reporting errors to be made, and hence a supervisor has to examine the booklet for accuracy prior to its submission to the Criminal Justice Unit (CJU). More problems could be initiated by the CJU clerk, who then transfers the information onto the Collision Reporting System (CRS) system. The City of London road safety manager then transfers all this information onto an MS Access database, prior to the information being used to produce local statistics. Monthly data is then sent to the Metropolitan Police, who report the figures to the Department for Transport (DfT).

DfT are then able to compile national statistics (STATS 19), however one can see that there are potential hazards with accuracy, when using so many layers of reporting. The DfT make specific comment around the strengths and weaknesses of the data in their latest quarterly provisional estimates release : " police data on road accidents (STATS 19), whilst not perfect, remain the most detailed, complete and reliable single source of information on road casualties covering the whole of Great Britain, in particular for monitoring trends over time" (Department for Transport 2014b, p.8)

Data Collection, Assessment and Cleansing

All injury collision data for the two (financial) year period of April 2010 to March 2012 has been reviewed. These data have been overlaid across the 22 enforcement locations. The data are quantitative and are able to be defined and delineated unambiguously, which will help with any efforts to establish any correlation coefficient (Jupp, 1989).

Statistical data are available for a two (financial) year period, for both collisions and enforcement, including the variables of known enforcement locations, time, day, casualty type, mode of transport, 'causation' factors (in this case a road traffic not scientific term), along with Global Positioning System (GPS) eastings and northings for both collisions and enforcement locations. The latter were missing from a small number of collision records and have been manually corrected. An example of the Excel data capture sheet is shown at *appendix* B. Some of the 948 records examined were missing GPS coordinates, these records were adjusted manually, and likewise a small number of collisions were categorised incorrectly (slight, serious and fatal). These collisions were cross referenced with the CRS system, applying a secondary check of examining the 'comments' field to ensure that the mistakes were rectified. Once the data had been cleansed it was ready for further analysis.

In an attempt to measure enforcement outputs the number of fixed penalty notices (traffic tickets) issued during enforcements were collected to establish the amount of activity at each enforcement location. The TFL funded interventions are split broadly into the two areas: education and enforcement. This study has concentrated primarily on those operations where enforcement was delivered and fixed penalty notices issued. The selection of enforcement locations, for analysis and the accuracy of their comparable data sets has been undertaken in order to reflect 'daily business' as best as possible, in order for there to be sufficient confidence around the internal validity of the study (Robson 2011, p.88).

A total of 23 enforcement locations were used for traffic interventions by the City of London Police during the two year period of analysis. GPS eastings and northings were obtained for all 23. This study has decided to omit one of these locations from the results: Cheapside/Bank Junction, due to an analytical error which saw this site omitted from the proximal CoLCHI calculations. Any comparison between base value and proximal models of collision harm would therefore have been unequal in terms of enforcement site numbers; hence the location has been disregarded. Road safety tasking is decided on a monthly basis, and the resourcing requirement is driven through the force tasking group, locations for activity and bids for officers are made for educational and enforcement activity. In a typical month up to 8 locations are selected for enforcement, along with a suggested period of days and times to deliver the interventions. Between five and seven days are identified and selected each month. Enforcement officers then record a master sheet detailing all outputs generated from these operations (primarily fixed penalty notices), which is then submitted and recorded by the STOT team. Monthly spreadsheets are prepared from the information provided by the STOT team. The data are cleansed, by manual corrections, and the outputs verified as having been completed and submitted for the days and dates and times in question.

Initial examination of the enforcement data showed that interventions were not consistently delivered at each of the 8 monthly selected sites, with the majority of months seeing verified enforcement activity across only a selection of the locations. Any location without any measurable enforcement outputs recorded against it has an assumption that no intervention was delivered there that month. Other categories for this study include: site not selected for enforcement that month and site selected with measurable outputs. Table 2 shows 5 of the selected 8 enforcement locations for the month of July 2010. The grey shaded area represents the days selected by the STOT team to deliver enforcement for that particular month. The numbers within the table relate to numbers of tickets issued at the relevant time and day:

	1. North area Bishopsgate Middlesex Street								st are	a Flee	t St J/V	N Lud	gate C	ircus	3. West area Holborn Circus							4. South Area, Upper Thames Street Southwark Bridge cycle super highway								5. West Area Fleet Street J/W Fetter Lane							
Jul-10	07:00-10:00	07:00-14:00	06:60-06:20	08:00 - 10:00	14:00-20:00	15:00 - 17:00	18:00-20:00	07:00-10:00	07:00-14:00	02:30-06:30	08:00 - 10:00	14:00-20:00	15:00 - 17:00	18:00-20:00	07:00-10:00	07:00-14:00	06:60-06:20	08:00 - 10:00	14:00-20:00	15:00 - 17:00	18:00-20:00	07:00-10:00	07:00-14:00	06:60-06:20	08:00 - 10:00	14:00-20:00	15:00 - 17:00	18:00-20:00	07:00-10:00	07:00-14:00	06:60-06:20	08:00 - 10:00	14:00-20:00	15:00 - 17:00	18:00-20:00		
1st																																					
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3rd																																					
4th																																		-			
5th	4	3			1		3		5					1		2			1			1				1			1								
6th	2						1	1	2			2			2				1		2	3	1														
7th		2					3	1				2				1							2			1		2		3							
8th					3		1					1				1			1				1			3											
9th					2		1		1					2	2	1							1					1	1								
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12th		2					3	1	1							3			1		1	1				1		3							1		
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TABLE 2 INDICATION OF ENFORCEMENT ACTIVITY RECORDED JULY 2010

It is clear, as a result of the initial analysis that some high harm collision locations were not subject to any enforcement. 11 of the 22 enforcement locations didn't receive any intervention activity at all in 2010/11, and 7 of those 11 received limited enforcement during 2011/12. Data are examined from April 2010 up to and including March 2012, after which policing activity was heavily influenced by the London Olympics. The enforcement activity during this former timeframe was delivered exclusively by roads policing personnel, as opposed to officers from a variety of frontline units, reducing the chance of inconsistency and providing confidence for this thesis around dependable operational delivery (Bachman & Schutt 2010, p.107).
<u>Analysis Methodology – City of London Collision Harm Index (CoLCHI)</u>

Whilst the numbers of both enforcement operations and the collision rates for the chosen locations are important, to provide more depth to this study the research uses a Collision Harm Index. This index weights the severity of injuries caused, providing an illustration of harm, as opposed to just raw counts of incidents. In order to help shape future policy around financial commitment and effective targeting (Department for Transport 2012b; Department for Transport 2014a), it is important to obtain a picture of the social and economic costs which stem from injury collisions. Three measures discussed include the loss of output for a casualty, human costs and medical and ambulance costs. Data and formulas for calculating casualty, accident and prevention costs are articulated in a recent paper (Department for Transport 2012b), set out earlier in Table 1 and repeated here:

Base damage:

- Slight = $\pounds 14,760$
- Serious = $\pounds 191,462$
- Fatal = $\pounds 1,703,822$

Source DfT (2012b)

Enforcement locations could be plotted onto a geographic information system (GIS), as the GPS locations for all 22 of them had been stored. The locations then had a 200 metre circle drawn around them, in order to contain and identify which injury collisions had occurred at or near a specific location. The distance was considered carefully and chosen in order to capture injury collisions occurring within the potential 'scope' of the traffic operation at a specific location. Too short a 'zone' would not include incidents happening on approaches to the relevant location. A GIS 'near' tool was used, calculating the GPS locations for each collision and compiling a list of collisions occurring within a 200 metre distance, for each of the 22 enforcement locations. A number of options were considered with which to capture collision information, relative to specific enforcement sites, including grid sectorisation or manual selection of streets surrounding the relevant sites. This thesis suggests that a consistent methodology be used for each enforcement site, so that each location can be awarded a CoLCHI score, being the sum of all collisions and their harm rating. In order to compare the sites, the geographic footprint should be exactly the same for all 22.

Crime mapping has been used extensively for a number of years, concentric circles being used to 'zone' activity, which in turn highlights spatial distribution of crime, alongside any social indicators (Bachman & Schutt 2010, p.340). This study seeks to identify a similar distribution of collision harm: the geographic context with proximity to enforcement locations is important in order to test whether the locations chosen for enforcement are also those with the greatest harm scores. These circular zones appear to be a suitable method with which to map the spatial distribution of collisions, relative to the centre of the site.

There are currently 23 traffic enforcement locations which are regularly used in the City of London (22 of which are examined in this study). Figure 1 below illustrates the locations and interconnectivity of these locations within the City of London. The centre of each location is depicted by the police car surrounded by concentric circles; the outer circle of each represents the 200m zone. Personal Injury data from April 2010 through to March 2012 has been overlaid onto the map in order to demonstrate the spread of these events across the City.



FIGURE 1 ENFORCEMENT LOCATIONS AND PERSONAL INJURY COLLISIONS 2010 TO 2012

Each of the 22 enforcement sites has been analysed for the months from April 2010 to March 2012. Base values have been applied (Department for Transport 2012b) to each injury collision within each locations 200 metre enforcement zone. Where a collision is shown within the 200m zone of more than one site, its score has been attributed to each one, on the basis that its presence is relevant to each of the areas when weighting the collision harm score for individual sites. The sum of all injury collisions within the zone provides a CoLCHI score for that enforcement location for that month, which can then be summed for the year. Each site examined on this basis for month to month comparison, additionally using the sum of all months to determine the yearly CoLCHI score for the relevant site. A snapshot example is displayed at Table 3 below, showing the scoring for 6 of the enforcement sites for a selected period of 16 months. The blue graduated data bars indicate where the scoring is highest.

		BishopsgateBetweenCamorr	EastAreaAldgateHighStreet	EastAreaAldgateHighStreetF	EastAreaEastcheap_JW_Lon	GracechurchStreetBishopsga	KingStCheapsidePoultry
		А	В	С	D	E	F
2010	April	0	0	14760	14760	0	14760
2010	May	220982	0	2 20982	44280	44280	220982
2010	June	14760	29520	29520	14760	14760	2 35742
2010	July	44280	0	29520	14760	0	0
2010	August	206222	0	0	59040	206222	14760
2010	Septembe	0	0	0	29520	0	14760
2010	October	14760	29520	29520	29520	44280	29520
2010	November	29520	29520	14760	206222	29520	14760
2010	December	0	29520	29520	14760	0	191462
2011	January	29520	14760	14760	206222	14760	14760
2011	February	44280	29520	29520	14760	0	0
2011	March	0	0	14760	44280	382 <mark>924</mark>	44280
2011	April	0	14760	29520	0	0	220982
2011	May	29520	0	29520	2 35742	0	220982
2011	June	0	29520	14760	44280	0	0
2011	July	412 <mark>444</mark>	191462	603906	0	14760	412444

TABLE 3 SNAPSHOT OF COLCHI SCORING 6 SITES 16 MONTHS

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The 22 enforcement locations are ranked in order of highest to lowest CoLCHI score for each month. The top 8 sites in terms of collision harm will then be compared to the actual 8 sites chosen that month for enforcement, to establish whether the targeting decisions were made in line with actual collision harm. A percentage calculation will show where the greatest percentage of harm sits on a yearly basis. A yearly sum of each site score can be used to provide a more meaningful total going forwards, whereby on the first of each month the sum of the previous twelve months ranked scores can be assessed to enable targeting decisions to be made. Further analysis will show which of the chosen enforcement locations actually delivered intervention by issuing fixed penalty notices, and whether these sites were amongst those with the greatest collision harm. This part of the analysis will be depicted on a scatter plot. Fatal collisions involve enormous costs that are orders of magnitude larger than other collisions, including those which involve serious injury. These fatal collisions, will inevitably, push the scoring to an exceptionally high level, resulting in an enforcement location remaining 'hot' over the course of a twelve month rolling analysis. Targeting decisions could subsequently be adversely affected. Consideration was given during this study to classifying fatal collisions as serious (in terms of a CoLCHI score), in order that the enormous spikes in collision harm, attributed as a result of these events, can be evened out whilst still capturing the seriousness of the event. This consideration, however, would ignore the figures and methodology set out in the literature, used to calculate the financial cost of these traumatic events, hence this musing has been discounted.

Targeting decisions made tomorrow arguably need to give increased weight to events that have occurred in the recent past. A fatal collision happening 11 months ago will keep an enforcement location 'glowing red' throughout the year, with its relevance (for tasking) arguably dissipating with the passage of time. It is for this reason that this thesis will argue that a CoLCHI should include a reference to when the collision occurred. Collisions happening in the recent past should attract a higher weighting than those occurring in the more distant past. In order to test whether our enforcement locations are the right ones, each collision should also be weighted in relation to its proximity to the centre of the chosen location: reducing in weighting the further out from the centre it is recorded. This study therefore additionally examines a 12 month period, pre April 2011, in order to establish whether a 12 month time and distance formula will provide a more meaningful collision harm scoring with which to inform targeting decisions.

Time and Distance Collision Harm Calculation

The time and distance CoLCHI is calculated using the following formula:

CoLCHI = \sum base damage x geographic distance coefficient x temporal distance coefficient

Base damage: (Source DfT, 2012b)

Geographic distance coefficient:

Collision's distance from centre of enforcement location:

0-50m = 1.0

50-100m = 0.75

100-150m = 0.50

150-200m = 0.25

These distances are a straight line distance from a given centre point (the enforcement location). As all injury collisions and enforcement locations contain accurate mapping coordinates, geometry based analysis selects and classifies collision events appropriately. Figure 2, below, shows how a geometry based selection was used to select four casualty events that are between 150-200 metres from the enforcement location (centre point). The inner ring of the 'target' represents the centre of the enforcement location. The graduated dots represent collisions. These selected points are then given a 'geographic distance' classification of '0.25'. The same process is conducted for events at 150-100, 100-50 and 50-0 metres and classified 0.50, 0.75 and 1.00 respectively. Figure 2 shows 5 slight injury collisions; four sit in the 150-

200 metre zone with one in the 50-100 metre zone at Gresham Street. This particular collision attracts a higher score as it is closer to the centre of the enforcement location:

 \sum £14,760 x 0.75 (geographic score) x 0.2 (temporal score) = £2214. *By way of comparison the slight injury collision at Ironmonger Lane attracts a lower score as it is further away from the centre*:

 $\sum \text{\pounds}14,760 \ge 0.25$ (geographic score) ≥ 0.3 (temporal score) $= \text{\pounds}1107$



FIGURE 2 GEOGRAPHIC DISTANCE COEFFICIENT AT AN ENFORCEMENT LOCATION

<u>Temporal distance coefficient:</u>

Every injury collision contains a date record, used to generate a date score for each event. The date scores are based around a control date (01 April 2011), being the point succeeding twelve months analysis, and key for indicating which locations would have been optimal for targeting in April 11. As the injury collision date increases further away in time (prior to April 2011) from the control date the temporal distance score decreases. For simplicity, the sample data represents 12 months pre control date (total 12 month sample). Also to aid the calculation process, the 12 month sample was divided into 10 time envelopes, each of 36 days, with each time envelope diminishing by 0.1 as it moves further from the control date. Figure 3 below illustrates the time envelopes and associated scores:



01-Apr-11 Control Date (Moving in 36 day time blocks)

FIGURE 3 TIME ENVELOPES AND COLCHI SCORING

The ESRI arc mapping Global Information System (GIS) tool was used in order to calculate the CoLCHI score for each injury collision at each enforcement location. The mapping platform used location scores calculated for geographic distance, and then a date score for temporal distance, subsequently multiplied by the base damage figure, resulting in a collision harm index total score for each event, summed to provide a total for the site. Whilst the sum of scores for the relevant site provides a measure of harm, when compared against her

locations, visual symbols are used to demonstrate not only the location of the collision but the magnitude of harm.

Proximal calculations and graduated symbol mapping

Example Using the Control Point of 1/4/11 and displayed in Figure 4:

Serious Collision 30/09/10 at Ludgate Circus. This particular collision is centred in the middle of the enforcement site thereby attracting a full geographic score of 1. It occurred in September some seven months before April 2011, thus attracts a temporal multiplier of 0.5:

 $\sum \text{\pounds}191,462 \quad x \ 1.0 \text{ (geographic score)} \quad x \ 0.5 \text{ (temporal Score)} = \text{\pounds}95,731$

Compare this to the serious injury collision displayed as a red dot which is away from the centre of the enforcement location but occurs on 28/10/10, a more recent collision, and the reduction in harm score because of distance is clear.

 $\sum \text{\pounds}191,462 \ge 0.25$ (geographic score) ≥ 0.6 (temporal score) $= \text{\pounds}28,719$



FIGURE 4 GRADUATED SYMBOL MAPPING AT LUDGATE CIRCUS

Each of the 22 sites has a sum of all incidents CoLCHI score displayed within the individual mapping for the relevant enforcement location, a small number of maps will be used to depict location scoring and the spread of harm. Mapping visually demonstrates, through graduated symbols, exactly where the greatest harm occurs within the 200 metre zone of that site for the twelve month period. The bigger the symbol, the greater the harm score.

Sites will be ranked from 1 to 22 in relation to their CoLCHI score and can then be compared against the sites which were actually chosen for enforcement in April 2011. Additional analysis will compare the non-proximal CoLCHI scores with the time and distance CoLCHI scores for the same year, in order to establish whether there would have been any change in targeting decisions between both approaches. It should be noted that the theory of applying temporal and geographic decay to accurately articulate collision harm, is new and previously untested. This study provides an opportunity within which to test this approach, comparing the new proximal theory and formula to raw collision counting and un-decayed CoLCHI values.

Enforcement data will be compared against the highest scoring sites in order to examine whether fixed penalty tickets were issued at the sites with the greatest harm.

Findings

Introduction

In order to answer the research question: "*Have enforcement locations (for operations)* been selected in line with evidence of harm"? Careful selection and subsequent analysis of the relevant data have been essential, providing results which are tangibly linked to this study. All injury collisions recorded between April 2010 and March 2012 were subject of analysis. A GIS tool was able to identify the injury collisions within a 200 metre radius of each of the 22 enforcement sites. The total number included in the dataset was *n*=948. Relevant Department for Transport harm values, for injury prevention (Department for Transport 2012a; Department for Transport 2012b), were applied to each injury collision. This allocation of 'injury value' provides the basis of the City of London Collision Harm Index (CoLCHI):

- Slight = $\pounds 14,760$
- Serious = $\pounds 191,462$
- Fatal = $\pounds 1,703,822$

Source DfT (2012b)

The CoLCHI scores for each enforcement site were summed providing monthly and yearly totals which were ranked, providing an 'at a glance' indication of high scoring sites. This showed, for example, that enforcement site 'O' was ranked as the number 1 site for three monthly occasions during 2010/11 and three times again in 11/12. Despite exhibiting such high levels of collision harm, this particular site was chosen to deliver enforcement only once during the entire two year period of analysis. Percentage analysis shows this particular site carried 14% of the total collision harm for the year 2010/11, the highest for any site, and 7.42% of the total value in 2011/12.

Whilst useful to provide a monthly snapshot of collision harm scoring, it is evident that using just the base value for fatal collisions (\pounds 1.7m) will elevate the CoLCHI scoring to extremely high levels. February 2012 saw enforcement site 'M' record two fatal collisions in one month, attracting a monthly CoLCHI score of \pounds 3,451,924: 87.63% of the total collision harm for all 22 sites that month. Whilst the high score should arguably inform traffic enforcement targeting decisions, in this case the location was not chosen the following month for targeted enforcement. However it was chosen 9 times prior to February 2012 for enforcement activity when the scoring was much lower.

High CoLCHI scoring in one month will not necessarily take account of previous monthly scores for the same location, if each month is analysed in isolation. Using this example, site 'M' recorded three months with a CoLCHI score of 0, immediately prior to February 2012. Analysis examining only the base-CoLCHI suggests that sites were selected for enforcement seemingly on the basis of convenience for the police, as opposed to being correlated to where the collision harm is greatest. Base value collision harm calculations demonstrate the extent of collision harm within the 200 metre zone of an enforcement location by displaying a numeric 'cost' value for each injury collision. These values are then summed providing a total for that location for the given time period, in this case by month then year. This study has additionally analysed 12 months collision data pre April 2011, using a base value multiplied by time and distance variables. The calculation used for this proximal modelling is:

CoLCHI= \sum base damage x geographic distance coefficient x temporal distance coefficient

The enforcement locations were then ranked using these CoLCHI scores: monthly and yearly for the base value model, and yearly totals for the proximal. The yearly rankings provide an opportunity to compare the two differing models. Each enforcement site has a sum of collision harm value against it for the year, taking into account the time and distance calculations for each injury collision event. A fairly clear picture became apparent, utilising the ESRI GIS tool graduated symbol mapping, where scores were grouped into ordered classes, each class assigned a graduated symbol and displayed smallest to largest. Simply put, the larger the circle on the map, the greater the collision harm score; illustrated in Figure 6 later in this section.

12 months analysis, using the proximal CoLCHI model, showed yearly scores ranging from £5,904 up to over £371,304. The time and distance scoring saw lower totals than the 'raw' base value calculations alone, due to the decaying effects of the time and distance variables. These adjustments to the formula effectively provided a reduction to the base value score, dependent upon the injury collisions' proximity in time and space relative to the control date of April 1st 2011.

The 8 sites selected for enforcement in April 2011 had 48% less collision harm scoring than the actual top 8. The latter having on average 2.9 times more CoLCHI scoring than the average location in the bottom 14 ranked locations. This difference is demonstrated later in this section in Figure 14. The analysis shows if the proximal CoLCHI was averaged across all 22 sites ,using the time and distance modelling, each site would receive 1/22 of total harm; any 8 having 8/22 or 36%, as opposed to the 33.7% the selected 8 sites actually carried. Thus even a random selection of enforcement sites, whilst not being evidence based, would have represented slightly better targeting than the system actually used.

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Base Value Only Collison Harm Index Scoring and Ranking

Two years secondary data was analysed from April 2010 through to March 2012, including *n*=948 injury collision events which were used to establish CoLCHI scores for the collisions themselves, along with scores for the 22 enforcement sites. The GIS 'near tool' selected every injury collision within the 200 metre zone of each of the 22 enforcement locations. The key for these locations is attached at *Appendix C*. Each collision was then allocated a base value, based upon the Department for Transport (DfT) figures for collision prevention costs.

Table 4, below, shows the financial year 2010/11 (April 2010 through to March 2011). Each enforcement site is indicated by an alpha symbol. The blue graduated data bars visually demonstrate the extent of scoring for the year, with site 'O' showing the highest CoLCHI score for the year 2010/11 with £1,930,216: 14.01% of the total collision harm score for the year, as opposed to the 4.5% (i.e., 1/22) that would occur if collision harm were distributed evenly across all locations. Noticeably a number of enforcement sites recorded duplicate figures, highlighted particularly in April 2010, where 7 of the 22 sites recorded slight injury collisions (base value= $\pounds 14,760$).

						FY 2	010/11							
Site	April	May	June	July	August	September	October	November	December	January	February	March	Total	CoLCHI %
Α	-	220,982.00	14,760.00	44,280.00	206,222.00		14,760.00	29,520.00	-	29,520.00	44,280.00	-	604,324.00	4.39%
В	-	-	29,520.00	-	-	-	29,520.00	29,520.00	29,520.00	14,760.00	29,520.00	-	162,360.00	1.18%
С	14,760.00	220,982.00	29,520.00	29,520.00	-	-	29,520.00	14,760.00	29,520.00	14,760.00	29,520.00	14,760.00	427,622.00	3.10%
D	14,760.00	44,280.00	14,760.00	14,760.00	59,040.00	29,520.00	29,520.00	206,222.00	14,760.00	206,222.00	14,760.00	44,280.00	692,884.00	5.03%
E	-	44,280.00	14,760.00	-	206,222.00	-	44,280.00	29,520.00	-	14,760.00	-	382,924.00	736,746.00	5.35%
F	14,760.00	220,982.00	235,742.00	-	14,760.00	14,760.00	29,520.00	14,760.00	191,462.00	14,760.00	-	44,280.00	795,786.00	5.77%
G	-	-	-	-	-		-		-	29,520.00	-	-	29,520.00	0.21%
Н	14,760.00	-	44,280.00	427,204.00	-	14,760.00	14,760.00	-	206,222.00	-	14,760.00	-	736,746.00	5.35%
I.	14,760.00	-	-	-	-	73,800.00	-	-	-	14,760.00	-	29,520.00	132,840.00	0.96%
J	44,280.00	44,280.00	29,520.00	235,742.00	14,760.00	-	-	-	-	73,800.00	382,924.00	14,760.00	840,066.00	6.10%
К	-	14,760.00	14,760.00	-	14,760.00	14,760.00	14,760.00	-	-	-	-	-	73,800.00	0.54%
L	-	-	14,760.00	427,204.00	-	14,760.00	14,760.00	-	-	-	-	-	471,484.00	3.42%
М	29,520.00	44,280.00	29,520.00	59,040.00	14,760.00	44,280.00	14,760.00	14,760.00	73,800.00	29,520.00	73,800.00	29,520.00	457,560.00	3.32%
Ν	220,982.00	29,520.00	250,502.00	-	29,520.00	29,520.00	29,520.00	59,040.00	191,462.00	14,760.00	44,280.00	73,800.00	972,906.00	7.06%
0	206,222.00	44,280.00	441,964.00	44,280.00	44,280.00	206,222.00	44,280.00	29,520.00	191,462.00	603,906.00	14,760.00	59,040.00	1,930,216.00	14.01%
Р	-	14,760.00	-	29,520.00	14,760.00	-	29,520.00	-	191,462.00	29,520.00	-	14,760.00	324,302.00	2.35%
Q	14,760.00	14,760.00	220,982.00	14,760.00	29,520.00	-	44,280.00	44,280.00	191,462.00	220,982.00	14,760.00	29,520.00	840,066.00	6.10%
R	-	-	14,760.00	14,760.00	29,520.00	29,520.00	44,280.00	-	191,462.00	220,982.00	-	206,222.00	751,506.00	5.45%
S	14,760.00	29,520.00	14,760.00	-	59,040.00	191,462.00	250,502.00	59,040.00	14,760.00	14,760.00	14,760.00	-	663,364.00	4.81%
Т	29,520.00	14,760.00	14,760.00	-	29,520.00	191,462.00	265,262.00	73,800.00	14,760.00	29,520.00	29,520.00	44,280.00	737,164.00	5.35%
U	-	14,760.00	220,982.00	44,280.00	191,462.00	-	-	-	-	-	14,760.00	-	486,244.00	3.53%
V	29,520.00	-	29,520.00	427,204.00	29,520.00	14,760.00	220,982.00	44,280.00	14,760.00	14,760.00	44,280.00	44,280.00	913,866.00	6.63%
Total	663,364.00	1,017,186.00	1,680,132.00	1,812,554.00	987,666.00	869,586.00	1,164,786.00	649,022.00	1,546,874.00	1,591,572.00	766,684.00	1,031,946.00	13,781,372.00	

TABLE 4 BASE VALUE COLCHI SCORES ALL LOCATIONS 2010/11

The number of duplicate entries means that certain sites will be ranked alongside each other for monthly comparison. The figures naturally begin to separate as the year progresses and more collisions are added. The ends of year totals demonstrate this separation, where there is a far clearer picture of collision harm by site over a 12 month period. Individual events at serious and particularly fatal categorisation pushed monthly and yearly totals up markedly. Arguably, this situation is exactly the purpose of the index; demonstrating peaks of harm to inform targeting decisions.

Further high scoring can be seen in Table 5, demonstrating the prominence of fatal collision scoring in February 2012, where two fatal injury collisions within the scope of enforcement site 'M' elevated the monthly CoLCHI score to £3,451,924 (highlighted in red): 87.63% of the total collision harm scoring across all 22 sites and contributing to the greatest CoLCHI score for the year with 22.05% of the total collision harm.

	FY 2011/12													
Site	April	May	June	July	August	September	October	November	December	January	February	March	Total	CoLCHI%
Α	-	29,520.00	-	412,444.00	250,502.00	206,222.00	220,982.00	206,222.00	73,800.00	29,520.00	14,760.00	14,760.00	1,458,732.00	7.06%
В	14,760.00	-	29,520.00	191,462.00	29,520.00	14,760.00	44,280.00	-	-	-	-	14,760.00	339,062.00	1.64%
С	29,520.00	29,520.00	14,760.00	603,906.00	14,760.00	-	29,520.00	191,462.00	14,760.00	14,760.00	14,760.00	-	957,728.00	4.63%
D	-	235,742.00	44,280.00	-	73,800.00	29,520.00	59,040.00	44,280.00	59,040.00	235,742.00	-	88,560.00	870,004.00	4.21%
E	-	-	-	14,760.00	265,262.00	206,222.00	427,204.00	29,520.00	44,280.00	14,760.00	-	44,280.00	1,046,288.00	5.06%
F	220,982.00	220,982.00	-	412,444.00	29,520.00	14,760.00	412,444.00	206,222.00	29,520.00	14,760.00	59,040.00	-	1,620,674.00	7.84%
G	-	14,760.00	-	-	14,760.00	-	14,760.00	-	-	-	-	14,760.00	59,040.00	0.29%
Н	-	-	29,520.00	14,760.00	14,760.00	29,520.00	-	14,760.00	-	-	-	-	103,320.00	0.50%
I.	-	-	14,760.00	-	44,280.00	-	191,462.00	14,760.00	29,520.00	44,280.00	44,280.00	-	383,342.00	1.85%
J	-	14,760.00	-	14,760.00	14,760.00	29,520.00	191,462.00	44,280.00	-	-	44,280.00	118,080.00	471,902.00	2.28%
К	44,280.00	-	-	44,280.00	-	-	14,760.00	-	14,760.00	-	14,760.00	-	132,840.00	0.64%
L	-	-	14,760.00	-	-	14,760.00	-	14,760.00	-	-	-	-	44,280.00	0.21%
М	-	29,520.00	44,280.00	427,204.00	59,040.00	250,502.00	220,982.00	-	-	-	3,451,924.00	73,800.00	4,557,252.00	22.05%
N	206,222.00	220,982.00	14,760.00	427,204.00	59,040.00	14,760.00	412,444.00	220,982.00	29,520.00	44,280.00	59,040.00	-	1,709,234.00	8.27%
0	427,204.00	88,560.00	-	14,760.00	29,520.00	397,684.00	441,964.00	44,280.00	44,280.00	-	44,280.00	-	1,532,532.00	7.42%
P	14,760.00	14,760.00	-	-	29,520.00	-	29,520.00	250,502.00	-	-	-	29,520.00	368,582.00	1.78%
Q	44,280.00	44,280.00	-	-	14,760.00	14,760.00	59,040.00	59,040.00	14,760.00	59,040.00	29,520.00	-	339,480.00	1.64%
R	14,760.00	14,760.00	-	206,222.00	44,280.00	-	220,982.00	59,040.00	14,760.00	-	-	-	574,804.00	2.78%
S	29,520.00	14,760.00	191,462.00	441,964.00	14,760.00	220,982.00	59,040.00	14,760.00	29,520.00	29,520.00	73,800.00	206,222.00	1,326,310.00	6.42%
Т	29,520.00	14,760.00	-	412,444.00	29,520.00	44,280.00	44,280.00	29,520.00	14,760.00	29,520.00	59,040.00	220,982.00	928,626.00	4.49%
U	14,760.00	-	382,924.00	-	-	-	14,760.00	-	-	-	29,520.00	-	441,964.00	2.14%
v	397,684.00	-	-	456,724.00	235,742.00	191,462.00	44,280.00	44,280.00	14,760.00	-	-	14,760.00	1,399,692.00	6.77%
Total	1,488,252.00	987,666.00	781,026.00	4,095,338.00	1,268,106.00	1,679,714.00	3,153,206.00	1,488,670.00	428,040.00	516,182.00	3,939,004.00	840,484.00	20,665,688.00	

TABLE 5 BASE VALUE COLCHI SCORES ALL ENFORCEMENT LOCATIONS 2011/12

The yearly totals have not seen duplicated rankings in the same way as the monthly analysis, with monthly variation producing more accurate results which have less variability from sample to sample (Rumsey 2011, p.267). The monthly totals have been ranked for both years of analysis, demonstrating those enforcement sites that appear regularly near the top of the classification tables. Table 6 confirms the amount of duplication with monthly scores, represented by tied ranking values in this 2010/11 analysis. This table includes those sites ranked first, actually being duplicated for 3 of the 12 months shown. The horizontal columns help to show the sites graded as highest on more than one month throughout the year ('A', 'H' and 'O').

						FY 20	10/11					
	April	May	June	July	August	Septembe	October	Novembe	December	January	February	March
A	14	1	. 12	6	1	14	14	7	15	6	3	15
В	14	16	7	14	17	14	8	7	9	11	6	15
С	7	1	7	9	17	14	8	11	9	11	6	12
D	7	4	12	. 11	4	6	8	1	11	4	9	5
E	14	. 4	12	. 14	1	14	4	7	15	11	15	1
F	7	1	. 3	. 14	12	9	8	11	2	11	15	5
G	14	16	20	14	17	14	19	14	15	6	15	15
Н	7	16	6	1	17	9	14	14	1	19	9	15
1	7	16	20	14	17	4	19	14	15	11	15	9
J	3	4	. 7	4	12	14	19	14	15	5	1	12
К	14	. 11	12	. 14	12	9	14	14	15	19	15	15
L	14	16	12	1	17	9	14	14	15	19	15	15
М	4	. 4	. 7	5	12	5	14	11	8	6	2	9
N	1	9	2	. 14	7	6	8	3	2	11	3	3
0	2	. 4	1	6	6	1	4	7	2	1	9	4
Р	14	. 11	20	9	12	14	8	14	2	6	15	12
Q	7	11	4	11	7	14	4	5	2	2	9	9
R	14	. 16	12	. 11	7	6	4	14	2	2	15	2
S	7	9	12	. 14	4	2	2	3	11	11	9	15
Т	4	. 11	12	. 14	7	2	1	2	11	6	6	5
U	14	. 11	4	6	3	14	19	14	15	19	9	15
V	4	. 16	7	1	7	9	3	5	11	11	3	5

TABLE 6 ENFORCEMENT SITES IN RANK ORDER BY MONTH 2010/11

Yearly CoLCHI figures will, arguably, provide a more accurate method of analysing collision harm hot spots. Trends over time can be analysed, taking into consideration traffic flow and engineering changes which can, in turn, be compared with previous years' statistics and context (Department for Transport 2013a). The second year analysis (2011/12) saw a rise in the overall CoLCHI score for all 22 locations summed for the year:

$2010/11 = \pounds 13,781,372$

$2011/12 = \pounds 20,665,688$

This rise represents a 49% increase in overall CoLCHI score for 2011/12, when compared to 2010/11, best displayed in Figure 5, where the effect of 2 fatal collisions, in February 2012, at location 'M' is clearly visible. It should be noted, however, that 15 of the 22 enforcement locations, depicted on the x axis, saw increases when compared to the previous year, so it would be wrong to assume the yearly upsurge emanated exclusively from these fatal events. Such a marked rise in collision harm over the year 2011/12 raises the question as to the

effectiveness of targeting decisions for police intervention as it would appear, from the analysis, that traffic enforcement was not focused where the collision harm was greatest.



FIGURE 5 TWO YEAR ENFORCEMENT SITE COLCHI RANKING

Yearly totals, therefore, seem to provide a more holistic view of the enforcement locations' 'harm' rating and certainly see less duplication, which is present when conducting monthly stand-alone analysis. The financial value attributed by fatal collisions can push an enforcement locations CoLCHI scoring to very high levels, which should be kept in mind when making subsequent targeting decisions. The ranking described previously in Table 6 demonstrates stand-alone monthly snapshots, showing that enforcement locations are rarely ranked as highest scoring consistently throughout the year. Rolling years data would provide a more accurate and contextual figure with which to make targeting choices. The next section will examine targeting decisions, in order to establish whether there was any correlation between collision harm and intervention delivery.

Correlation of enforcement activity to collision harm

This study examined traffic enforcement data over the two financial year period from April 2010 to March 2012. A total number of 2620 fixed penalty notices (traffic tickets) were issued to road users during enforcement operations funded by Transport for London. 1033 tickets were issued during 2010/11 and 1587 during 2011/12, the latter year showing a 56.6% increase. The monthly occasions and locations selected for enforcement activity was not linked to where the collision harm was the greatest. The highest ranking CoLCHI location was selected for enforcement only four times in the 24 month analysis, twice in each year.

The values in Table 7 provide the harm ranking of each enforcement site, also demonstrating the position of a number of sites never being selected for enforcement, despite them ranking as the highest monthly CoLCHI location, indicated by the unshaded cells of the table. Notably sites: 'C', 'D', 'E', 'F', and 'H', 'N' and 'O'. Sites: 'A', 'Q', 'R' and 'S', likewise were ranked at either position 1 or 2, for individual months, but received little or no targeted traffic intervention activity throughout the year. The green shaded boxes in Tables 8 and 9 show that some enforcement locations were selected but failed to deliver any intervention at all. This lack of activity occurred 25 times throughout the year 2010/11 and 37 times in 2011/12, an increase of 48%.

		FY 2010/11											
	April	May	June	July	August	Septembe	October	Novembe	Decembe	January	February	March	
A	14	1	12	6	1	14	14	7	15	6	3	15	
В	14	16	7	14	17	14	8	7	9	11	6	15	
С	7	1	7	9	17	14	8	11	9	11	6	12	
D	7	4	12	11	4	6	8	1	11	4	9	5	
E	14	4	12	14	1	14	4	7	15	11	15	1	
F	7	1	3	14	12	9	8	11	2	11	15	5	
G	14	16	20	14	17	14	19	14	15	6	15	15	
Н	7	16	6	1	17	9	14	14	1	19	9	15	
1	7	16	20	14	17	4	19	14	15	11	15	9	
J	3	4	7	4	12	14	19	14	15	5	1	12	
К	14	11	12	14	12	9	14	14	15	19	15	15	
L	14	16	12	1	17	9	14	14	15	19	15	15	
М	4	4	7	5	12	5	14	11	8	6	2	9	
N	1	9	2	14	7	6	8	3	2	11	3	3	
0	2	4	1	6	6	1	4	7	2	1	9	4	
Р	14	11	20	9	12	14	8	14	2	6	15	12	
Q	7	11	4	11	7	14	4	5	2	2	9	9	
R	14	16	12	11	7	6	4	14	2	2	15	2	
S	7	9	12	14	4	2	2	3	11	11	9	15	
Т	4	11	12	14	7	2	1	2	11	6	6	5	
U	14	11	4	6	3	14	19	14	15	19	9	15	
V	4	16	7	1	7	9	3	5	11	11	3	5	
Location C	Chosen and	FPN Issue	d										
Location C	Chosen and	No FPN Is	sued										

 TABLE 7 SITES SELECTED FOR ENFORCEMENT 2010/11

Targeting decisions during the second year are spread more equitably, as per Table 8, but despite this change, it is clear that enforcement locations with the highest CoLCHI score are still not being selected for focused traffic enforcement in line with collision harm scoring. Notably, site 'M' recorded an exceptionally (caused by the rare occurrence of two fatal collisions) high score in February 2012 (£3,451,924), but was not selected for traffic enforcement the following month. Conversely, this site did receive enforcement activity for 9 of the months prior to February 2012, when the scoring was considerably lower. December was not chosen for traffic enforcement in either year, due to the competing policing demands of the Christmas crime campaigns.

						FY 20	11/12					
Location	April	May	June	July	August	Septembe	October	Novembe	Decembe	January	February	March
A	14	6	11	6	2	4	5	3	1	5	11	8
В	10	15	5	10	9	11	13	18	15	11	14	8
С	7	6	7	1	14	16	16	5	9	8	11	12
D	14	1	3	16	4	8	10	8	2	1	14	4
E	14	15	11	12	1	4	2	12	3	8	14	6
F	3	2	11	6	9	11	3	3	5	8	3	12
G	14	9	11	16	14	16	18	18	15	11	14	8
н	14	15	5	12	14	8	21	14	15	11	14	12
I	14	15	7	16	7	16	8	14	5	3	6	12
J	14	9	11	12	14	8	8	8	15	11	6	3
К	5	15	11	11	20	16	18	18	9	11	11	12
L	14	15	7	16	20	11	21	14	15	11	14	12
М	14	6	3	4	5	2	5	18	15	11	1	5
N	4	2	7	4	5	11	3	2	5	3	3	12
0	1	4	11	12	9	1	1	8	3	11	6	12
Р	10	9	11	16	9	16	16	1	15	11	14	7
Q	5	5	11	16	14	11	10	6	9	2	9	12
R	10	9	11	9	7	16	5	6	9	11	14	12
S	7	9	2	3	14	3	10	14	5	5	2	2
Т	7	9	11	6	9	7	13	12	9	5	3	1
U	10	15	1	16	20	16	18	18	15	11	9	12
V	2	15	11	2	3	6	13	8	9	11	14	8
Location Chosen and FPN Issued												
Location (Chosen and	No FPN Is	sued									

 TABLE 8 SITES SELECTED FOR ENFORCEMENT 2011/12

Tables 7 and 8 demonstrate that current targeting is at best sporadic, particularly evident for 2010/11. The highest scoring enforcement locations were only selected for targeting during the subsequent month on 2 occasions in 2010/11 ('L' in July and 'T' in October). It was slightly higher in 2011/12, when top scoring sites were selected for enforcement 3 times, although on 2 of these occasions no enforcement was actually delivered ('U' in June [no enforcement], 'A' in December and 'D' in January [no enforcement]). Enforcement was, however, delivered to selected sites 58 times in 2010/11, and 54 times in 2011/12.

The scatter plots shown at Figures 6, 7 and 8 show at a glance where there was a correlation between enforcement activity and high collision harm scores. Each month has 22 symbols, representing the relevant enforcement location. If enforcement was commensurate with (high) CoLCHI scoring the scatter plots would show the red diamonds higher up the charts. These red diamonds indicate where a location was selected for enforcement which was subsequently delivered. In Figure 6, June '10 and January '11 show this to be the case, but a large number of blue crosses, i.e. sites that were not selected for intervention are evident across the chart. The green crosses indicate the locations chosen where enforcement was not delivered and notably the vast majority of these sit below the CoLCHI score of £100,000, demonstrating that, regardless of whether enforcement was delivered or not, targeting decisions have not been made in relation to collision harm.



FIGURE 6 ENFORCEMENT CORRELATION SCATTERPLOT 2010/11

The previous subsection identified the effect that a fatal injury collision can have upon collision harm scoring. Figure 7 demonstrates this extreme high outlier score in February '12, and shows this location was not chosen for enforcement activity.



FIGURE 7 ENFORCEMENT CORRELATION SCATTERPLOT 2011/12



Figure 8, below, has redacted these events in order that a clearer picture of the spread of enforcement activity compared against collision harm scores, can be seen.

FIGURE 8 ENFORCEMENT CORRELATION SCATTERPLOT 2011/12 (2)

Collision and Enforcement Time Analysis

Time analysis was conducted in order to establish whether enforcement is being delivered commensurate with injury collision events. Two years' injury collision data appear in Figure 9 showing that peak times are (probably unsurprisingly for a city centre) mornings and evenings. This study will not delve further into the breakdown of which vulnerable road user groups are being injured at specific times, but suffice to say that enforcement should ideally correlate to not just the correct location at the right time, but should also identify which road users are more at risk at that particular time. This thesis has already identified that collision harm scores and traffic enforcement activity (by output) for 2011/12 increased by 49% and 56% respectively when compared to 2010/11.



FIGURE 9 INJURY COLLISIONS BY TIME OF DAY 2010 TO 2012

Figures 10 and 11 show the majority of this traffic enforcement activity took place at the right time, when compared to injury collisions in Figure 9. Whilst enforcement outputs increased during 2011/12, the collision harm also increased, by a similar percentage. It should be noted that the three fatal events over the two year period all occurred during the lunchtime hours.



FIGURE 10 TRAFFIC ENFORCEMENT BY TIME OF DAY 2010/11



FIGURE 11 TRAFFIC ENFORCEMENT BY TIME OF DAY 2011/12

Current targeting practice is not cognisant of collision harm: whilst enforcement is delivered at the right times, the wrong selection of location has meant that the 56% increase in enforcement outputs, for 2011/12, appears to be wasted effort when the 49% ascent of collision harm for that year is considered. It may be that enforcement is effective at reducing harm, but

was deployed to the wrong location; it may also be that enforcement has no impact on harm, regardless of its deployment location.

The base-value only CoLCHI scoring provides a platform with which to weight injury collision events. Analysis shows that monthly scoring will disgorge a number of duplicate results across the 22 sites, demonstrating yearly, or 12 month rolling totals provide a more meaningful frequency distribution, which better inform targeting decisions. Due consideration still needs to be given, however, of the presence of fatal events which can heavily skew scoring.

Targeting choices need to be informed by the most valid and relevant information available. This should include not only ranking of data, but comparisons of harm levels experienced at various times and places (Sherman 2013, p.377). This study goes on to explore a new theory that more recent events and patterns should inform police intervention tomorrow, in this case by introducing time and distance variables to the collision harm index formula.

<u>Time and distance (proximal) collision harm index</u>

In order to address 'outlier' concerns with fatal injury values, and to develop a new idea to test targeting; time and distance values were considered and evaluated. The 22 traffic enforcement locations, already used to analyse the 'base value only' City of London collision harm index (CoLCHI), were used again to depict injury collision locations within their boundaries. Each injury collision event is awarded the same raw base value that was used earlier, dependent upon its severity (Department for Transport 2012b), mirroring the first part of the analysis. A control point of April 1st 2011 was selected, in order to collate injury collision data for the previous financial year (2010/11). These collision events were plotted using Global Positioning System (GPS) coordinates within the 200 metre zone of each site. Each enforcement location additionally introduced concentric circles, delineating zones from the

centre, at 0-50m, 50-100m, 100-150, and 150-200m. Individual collisions were attributed with a geographic coefficient, dependent upon its proximity to the centre of the enforcement site:

Geographic distance coefficient:

0-50m = 1.0 50-100m = 0.75 100-150m = 0.50 150-200m = 0.25

The 12 month analysis period was split into 10 equal time envelopes, preceding and built around the control date of 1st April 2011. Every injury collision contains a date record, as each event date increases further away in time from the control point, the temporal coefficient score decreases. The time parcels are split into 36 day blocks, the block closest in time to the control date attracts a score of 1.0; each time parcel diminishes by 0.1 as it moves further away in time:

Temporal distance coefficient:

06-Apr-10	0.1
12-May-10	0.2
17-Jun-10	0.3
23-Jul-10	0.4
28-Aug-10	0.5
03-Oct-10	0.6
08-Nov-10	0.7
14-Dec-10	0.8
19-Jan-11	0.9
24-Feb-11	1

01-Apr-11 Control Date

The CoLCHI score for each injury collision event was thus calculated:

 $CoLCHI=\sum$ base damage x geographic distance coefficient x temporal distance coefficient.

The CoLCHI proximal formula was applied using Excel to generate a score for every individual injury collision at each of the 22 enforcement locations. This data was then visualised on each relevant enforcement location using graduated symbol mapping: the higher the collision harm score, the bigger the circle. By way of an example, all 22 enforcement sites are shown in Figure 12 with graduated symbol mapping visually highlighting the extent of harm, displayed as varying sizes of injury collision events.



FIGURE 12 ALL ENFORCEMENT LOCATIONS SHOWING HARM GRADUATION

The Cannon Street enforcement site is shown in Figure 13 below. This particular site generated the 3rd highest proximal CoLCHI score for 2010/11. Amongst the 35 individual injury events within this location are 8 serious injury collisions with CoLCHI scores ranging

from £4,786.55 up to £71,798. The latter being the highest scoring injury event for this site in the 12 month period of analysis. This serious injury collision, occurring on 1/9/2010, attracted a time coefficient of 0.5 (decaying by six months), indicated by the red arrow and being the larger of the two circles. In contrast, the lowest scoring slight injury collision which took place more than 11 months before the control date, attracted a time coefficient of 0.1 resulting in a CoLCHI score of just £369, indicated by the yellow arrow, its low number depicted by a much smaller circle.



FIGURE 13 CANNON STREET SHOWING PROXIMAL COLCHI GRADUATED SYMBOL MAPPING

The yearly sum of all injury collision scores was calculated for each location, allowing the sites to be ranked in proximal CoLCHI score order. Figure 14 shows the enforcement sites in rank order of proximal CoLCHI score, ranging from £371,304 down to £5904. The top 8 sites can be seen towards the left hand side of the *x* axis. Despite the top 8 carrying 62.2% of

the CoLCHI total for the year, the sites displayed in red ('Q', 'T', 'V', 'M', 'L', 'A', 'C' and B') were those selected for enforcement in April 2011. These locations carried only 33.7% of the yearly proximal CoLCHI scoring, just under half the harm scoring of the actual top 8.



FIGURE 14 PROXIMAL COLCHI SCORING AND RANKING APRIL 2011

The proximal CoLCHI scores are lower than the base value only calculations because of the added coefficient multipliers for time and distance, which have reduced the high scoring seen during the base value analysis. The time and distance multipliers have effectively reduced the initial base value amounts, which for the most serious of injury collisions has the effect of dampening the spikes seen with pure base value allocation of collision harm values. The figures for both methods of calculation are best viewed in Table 17 below, where the rankings for both can be examined. Two methods of CoLCHI calculation cannot be compared directly. It is possible, however to review the ranking of the enforcement locations, given that differing formulas were used to align them into an order at the conclusion of 12 months analysis. Interestingly, the bottom four locations are identically ranked, with the majority of other enforcement sites being within four rank places of their counterpart, a wider difference is seen towards the top of the table where the bigger scores of the base value CoLCHI show a greater difference between rankings than the proximal model scores.

Base Value CoLCHI	Location	Location	Proximal CoLCHI	Rank
1,930,216.00	0	J	371,304	1
972,906.00	N	Q	336,743	2
913,866.00	V	0	334,118	3
840,066.00	Q	R	328,890	4
840,066.00	J	E	314,920	5
795,786.00	F	D	277,459	6
751,506.00	R	Т	262,825	7
737,164.00	т	N	242,140	8
736,746.00	Н	V	241,075	9
736,746.00	E	S	225,103	10
692,884.00	D	н	164,650	11
663,364.00	S	F	157,733	12
604,324.00	А	М	154,611	13
486,244.00	U	L	131,482	14
471,484.00	L	A	93,262	15
457,560.00	М	U	72,947	16
427,622.00	С	P	72,240	17
324,302.00	Р	С	61,233	18
162,360.00	В	В	56,457	19
132,840.00	l .	l .	50,922	20
73,800.00	К	К	8,856	21
29,520.00	G	G	5,904	22
	Кеу		Identical Rank	
			Within 1 place	
			Within 2 places	
			Within 3 places	
			Within 4 places	

TABLE 9 COMPARISON OF BASE VALUE AND PROXIMAL COLCHI RANKINGS 2010/11

Proximal CoLCHI scores were used in order to create a heat map which reflects the collision harm, as opposed to raw quantitative figures. ESRI mapping, created an interpolated surface, using the sampled point values of individual injury collision events and their attributed harm scores. Figure 15 shows the extent of collision harm across the City of London for the 12 months preceding April 2011. Targeting choices appear clear, given this visual representation of the year (2010/11) analysis of injury collisions. The next section discusses the lack of targeting, in line with collision harm scores, at accepted enforcement locations, however it appears that the fixed locations themselves may have been poorly selected to begin with.



FIGURE 15 PROXIMAL HARM INDEX HEATMAP

Discussion

This study set out by asking the research question:

"Have enforcement locations (for operations) been selected in line with evidence of harm?" The findings section suggests this is not the case, as a result of descriptive analysis, which has examined multiple layered elements. This thesis exploring injury collisions, their seriousness, prevalence and harm rating; alongside traffic enforcement and its correlation to collision harm in the City of London. Whilst enforcement was delivered at the right times, the analysis indicates it was at the wrong locations.

Enforcement Locations

22 enforcement sites, currently used by the City of London Police were 'cocooned' within their own 200 metres zones, capturing all injury collision events therein, utilising a GIS 'near' tool to map the data. Whilst these locations offer a good spread of options for traffic intervention across the City of London, they have been used for some time and don't necessarily capture all current micro locations where harm is prevalent. The sites are most likely chosen (and continue to be used) for police convenience. This is particularly apparent by the occurrence of a fatal injury collision in Moorgate in August 2010, just outside the 200 metre zone for an enforcement location, meaning its value and relevance was not included in this study. However, having looked at the data for this fatal event, this nearest enforcement location in question was still not selected for intervention the following month, thus demonstrating a lack of harm consideration when making tasking decisions.

Injury Collisions and Prevention Costs

Injury collision events are usually referred to in quantitative terms, when analysing data for policing purposes, excepting the Killed or Seriously Injured (KSI) category. This category is subject of a reduction target with the City of London Corporation, TFL and the Mayor of London, and sees fatal and serious events grouped together for the purposes of a performance target. This thesis saw an opportunity to attribute the DfT prevention costs (Department for Transport 2012b) to all injury collisions within the analysis envelope, in a policing jurisdiction.

Given the disproportionate number of vulnerable road users (VRU's) injured in the City of London (Everett 2013; Talbot et al. 2014), allocation of a preventative cost for all such injury incidents is not only appropriate but has focused attention towards the harm as opposed to just raw numbers. As far as the author is aware, this process has not been undertaken before, particularly in relation to creating a collision harm index.

Creation of the City of London Collision Harm Index

The Cambridge Crime Harm Index (CHI) (Sherman et al. 2013; Sherman 2013) was instrumental in sparking an idea that injury collisions could be weighted commensurate with the harm they caused. The City of London Collision Harm Index (CoLCHI) adapted the concepts used in the CHI replacing sentencing guidelines for crimes, with collision preventative values, documented in the literature and introduced by the Department for Transport (Department for Transport 2012a; Department for Transport 2012b).

Each injury collision was awarded a value in line with its seriousness (slight, serious or fatal) and in its most basic form, these 'raw' values can paint an instant picture of harm distribution and frequency, especially when plotted on a map. The fatal values (£1.7m), in
particular, are instantly recognisable, which is partly the point of the index. However, depending on how the CoLCHI is interpreted, a fatal occurring in April could leave its location glowing red for up to a full year afterwards, even though it's immediate importance for targeting will wane over time. The addition of time and distance coefficients, creating a formula rather than a single value, helped to soften the spikes caused by the raw values alone; presenting a more meaningful method of testing targeting decisions. The additional proximal 12 months analysis was helpful to compare the two models.

Enforcement Location Ranking

The CoLCHI provided each individual event with a financial harm value, summed for all incidents within each enforcement zone, thus providing a score and subsequent ranking against the other sites. Stand-alone monthly ranking (base value only) proved problematic because of the prevalence of duplicate entries, a challenging situation for realistic and meaningful targeting decisions to be made. The yearly totals realised greater separation between enforcement site harm scoring, demonstrating better patterns and context of harm over time.

Again, the fatal preventative values had enormous impact, particularly with the base value only CoLCHI model, but a comparison of both approaches demonstrated similarities with site ranking using the 12 month pre April 11 analysis. Both methods were effective in recognising and ranking locations by harm value, although the proximal model is the only method to take account of the decaying effects of time and distance.

Correlation of Enforcement Activity to Collision Harm

Once the sites were ranked in collision harm order, the enforcement activity was measured to establish when and where it occurred and whether any tickets were issued. The two financial years of 2010/11 and 2011/12 provided 24 months activity to scrutinise. These years were chosen as they weren't affected by the extra ordinary policing measures in place for the London Olympics. The results, whilst probably not unforeseen were startling: some high harm collision locations received no enforcement activity, with 11 of the 22 not seeing any intervention activity at all in 2010/11, and 7 of those 11 received limited enforcement during 2011/12. Traffic intervention was rarely delivered at the relevant location at or around the point in the year when the harm was greatest: only twice in 2010/11 and three times the following year. This finding, coupled with the discovery that many sites were selected for enforcement and didn't see any at all (25 times in 2010/11 and 37 times in 2011/12), indicates that harm is not being considered during targeting deliberations.

The proximal CoLCHI model was used to analyse 12 months injury data pre April 2011. Given that 12 months data should provide a better picture of patterns and context for targeting decisions, it is noted that the sites selected for enforcement in April 11 carried only 33.7% of the yearly proximal CoLCHI value. The actual top 8 had nearly double that amount of harm at 62.2%. In other words, the locations that were selected for enforcement precluded any consideration of evidence, resulting in a scatter gun approach which missed most of the high harm locations.

Current targeting decisions are made on a monthly basis, but that shouldn't mean that these choices should be restricted to the previous month's collision data in isolation. The findings tend to show that yearly analysis provides more breadth and depth to the data, which if used on a rolling basis (with either base value or proximal CoLCHI scores) could far better inform where police traffic enforcement assets are tasked. Roads Policing Unit (RPU) officers were gainfully employed with traffic enforcement during the analysis period, actually showing a 56.6% increase in productivity in the second year (tickets n=1083 2010/11 1587 2011/12), unfortunately, the collision harm score also rose for the same period by 49% (CoLCHI $\Sigma = \pounds13,781,372$ 2010/11 $\pounds20,665,688$ 2011/12) demonstrating that the interventions were probably in the wrong place. Outputs alone should not be an indication of success; they need to be tangibly linked to an outcome which in this case is a reduction in collision harm. If we accept that enforcement can have an impact on driving behaviour (Walter et al. 2011; Broughton & Elliott 2004), then it is essential that it is targeted in the most effective way.

Thesis Context with Existing Literature and Research

Vulnerable road users continue to be fatally and seriously injured on the City of London's ancient road network. Recent figures underlining that whilst the headline figure of injury collisions has reduced, the serious casualties continue to increase (Rickwood 2014; Talbot et al. 2014). There are, of course, many and varied reasons for this phenomenon, and enforcement has but a part to play in a picture including education and engineering initiatives (Transport for London 2014d). But at a time when the harm levels have increased, it is logical to define its presence, frequency and context with an index (or measure) of this harm. Such a method would follow the principles and ideas of the Cambridge Crime Harm Index (Sherman 2013; Sherman et al. 2013), to focus targeted enforcement where its impact will be of greatest benefit.

This thesis has identified intuitive tasking decisions, made over at least a 24 month analysis period, which have seen sporadic tasking choices made for either convenience or driven by subjective views, reaching conclusions on the basis of limited evidence (Kahneman 2011). The ideas posited in this study encourage future tasking choices to consider facts which are unknown, having a wider view and considering, amongst other information, the scores generated by a collision harm index.

Studies show that transgression of traffic legislation and hazardous driving behaviours are linked to collisions (Factor 2014; Parker et al. 1995). Previous academic studies have also suggested that focused traffic intervention has an impact on reducing offending behaviour (Walter et al. 2011; Broughton & Elliott 2004; Elvik & Christensen 2007; Scottish Office Central Research Unit 1997; Davis et al. 2006). These studies, however, typically examined road safety by simply counting collisions, and did not attempt to provide any summary measures of changing levels of harm.

This study actually saw an increase in collision harm scores over 2011/12 when compared to the previous year of analysis, despite a similar increase in enforcement outputs, suggesting that targeting was in the wrong place. Road safety depends heavily upon altered (lawful) behaviour, resulting from the perceived threats of being caught and being punished quickly (Homel 1988; Davey & Freeman 2011). The increase in collision harm during the period of analysis for this thesis unfortunately indicates that there is no evidence of altered behaviour as a result of traffic enforcement activity. This may be because the intervention was delivered in the wrong place, or indeed that it is simply not effective. Further research may indicate some changes in trends between differing road user groups, perhaps using more optimal data which has not been possible to explore for this study.

Limitations of Research

The concentric zones placed around each enforcement location certainly captured relevant injury collision data for the central site location and its approaches. However some collisions inevitably fell outside the boundaries of these sites, resulting in a number of events which were not included in the analysis. Most notably, a high harm fatal collision was left uncounted for this very reason. One high scoring location was omitted from the analysis due to an analytical error, which was unfortunate as this location would have added extra breadth and depth to the study. With the benefit of hindsight, a grid system would capture every square inch of a police areas jurisdiction, although the number of sites or the geographic area around each location would almost certainly increase.

The CoLCHI was approached using two different models. The base-value only calculations provided a clear indication of harm across 24 months, with the yearly analysis arguably offering a more accurate presentation of patterns and context. It wasn't possible to run an extensive analysis using the proximal CoLCHI formula, which meant that monthly analysis was not carried for all 24 months of the analysis period, which would have mirrored the base value only model. The single month analysis for April 2011 was, however, useful to compare against the base value calculations demonstrating that the harsh spikes, caused by the high fatal values, were somewhat softened in the proximal CoLCHI research over at least two years, with monthly figures would have provided greater confidence with this new idea. However the initial findings of the proximal model indicate a promising way forward, recognising the effects of time and distance decay and their relevance for targeting, the added breadth and depth outweighing the benefits of the base-value only system.

It wasn't possible, within the scope of this thesis, to additionally examine those slight injury collisions which could cross the line becoming serious or fatal events. Often, this results from a "matter of chance, depending upon the simultaneous occurrence of a number of additional random factors" (Factor 2014, p.90). Further research into the complexities of road layouts, vulnerable road users and collision 'causation' factors specific to the City of London will add value to the future assessment of collision harm.

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Strengths of Research

Whilst the proximal model of CoLCHI calculation partly ventured into unchartered territory, the base value model provided a strong footing for this study, derived from existing literature and research by the DfT (Department for Transport 2012a; Department for Transport 2012b). Both models, however, took direction and influence from the extensive research into a Crime Harm Index model (Sherman 2013; Sherman et al. 2013) and its importance with recognising the extent of harm caused by individual events. The base value model, whilst prone to giving fatal events excessive weight as potential outliers, managed to articulate a clear picture of collision harm within the enforcement site zones in the City of London, especially using the yearly figures. The resultant analysis clearly indicates that previous targeting decisions took virtually no account of collision harm.

The new theory in utilising additional time and distance coefficients shows promise as a basis for future research, developing benefits for targeting practices. The time and distance elements of the formula should help with ensuring our police officers are deployed in the right place, recognising the importance of more recent traumatic injury events.

Despite the limitations set out within this chapter, this is the first time that a piece of research has addressed the issue of the harm caused by collision events, recommending the use of an index with which to effectively target police traffic enforcement.

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Conclusion

The research carried out for this thesis, based within a small territorial policing district, may be viewed by some to provide limited generalisability. However, the extent of road deaths and serious injuries is a worldwide problem. It is particularly prevalent in busy urban settings like the City of London, where vulnerable road users are far more likely to be killed or injured than in surrounding boroughs (Everett 2013). Road deaths increased by 3% nationally this year (Department for Transport 2014b) and the City of London has seen an increase in serious injury collisions, despite the figure for all injury collisions reducing slightly (Rickwood 2014).

This study set out to examine whether enforcement locations had been selected in line with evidence of harm. In spite of the recent increase in KSI incidents, findings for this thesis demonstrate that traffic enforcement targeting decisions have not considered the issue of collision harm which, in light of the uplift in casualties, is striking. Police resources should not be squandered delivering enforcement in a haphazard fashion.

Traffic enforcement has a key part to play, alongside education and engineering activity, increasing road safety by altering driving behaviour (Factor 2014; Transport for London 2014b; Transport for London 2012c). Whilst TFL are now starting to take a far more risk-based approach to analysing road user behaviour in London (Transport for London 2012a), harm itself has not been considered, save for the preventative values placed on injury collisions by the Department for Transport (Department for Transport 2012a; Department for Transport 2012b). The City of London Collision Harm Index is a method with which to help identify locations and patterns of harm, providing far better evidence based choices for traffic enforcement targeting.

Implications for Future Research

The CoLCHI is a new idea, particularly when incorporated with the time and distance coefficients; as such, this descriptive analysis serves as an effective starting point articulating the presence and seriousness of a phenomenon. This study has gone on to demonstrate, by applying the CoLCHI that current targeting practices do not take into consideration the evidence of harm. The theoretical case for applying a collision harm index should be explored further by conducting further research, ideally using the most recent post Olympics data in order that targeting decisions using the CoLCHI results may have improved confidence.

A scientific trial would be the most effective method with which to carry research forward, at least at level 3 on the Maryland Scale of Scientific Methods, where a before and after experiment, with control group, could test the effectiveness of the harm index as an outcome variable (Sherman et al. 1998; Sherman et al. 2013). The CoLCHI could be used to target interventions, whilst existing methods of selection would be deployed to control areas. A level 5 randomised controlled trial would additionally add value by eliminating the risk of 'chance happenings' and selection bias. Any subsequent reductions in collision harm at selected intervention sites could be scientifically assessed for a causal relationship, which has not been possible within the scope of this study. There may also be value in re-examining some old experiments which test the effectiveness of enforcement, by re-analysing, using a collision harm index as an outcome measure, as opposed to straight collision counts. Harm indexing should also be used in the future to identify the best and most needed locations for enforcement. This study was limited to 22 locations which are currently used; harm indexing would demonstrate any shift away from existing spots, defining new locations for targeted activity.

Policy Implications

Whilst this new theoretical approach will benefit from the increased rigour of scientific experiments going forwards, there is a case to start work immediately on the basis of this descriptive study. Targeting decisions are already being made using the subjective intuitive view of 'subject matter experts' and at best on the basis of numbers alone. These decisions could be extended to include consideration of the harm factor. The base value only CoLCHI model can be very swiftly added to internal data cleansing processes as each new collision is recorded, prior to submission for inclusion in STATS 19 figures, providing a monthly score for all enforcement locations (which of course could be adapted to incorporate a grid or junction system). If the data was used on a 12 month rolling basis, collision harm could be effectively assessed as part of the force tasking mechanism. Its value could have wider implications for traffic enforcement policy pan London, where TFL funded enforcement could be delivered consistently, cognisant of harm avoiding 'knee jerking' into activity predicated upon the emotion of traumatic events in isolation.

The proximal model of harm analysis is the only model for calculating collision harm, which takes into consideration the time decay issues affecting injury collisions. The model used for this study relied upon a 360 day window of decaying effect, but this is just one possible variant. The question of how long a collision event should have an impact on police tasking remains an open one. Further analysis exploring this idea will allow greater assessment of the local dimensions of this idea.

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Application

Achieving more with less has become a phrase all too familiar with police agencies facing policing challenges with decreasing budgets. The collision harm index developed and demonstrated within this study provides a method with which to identify areas and patterns of harm in order to conduct pre-emptive interventions which can prevent or change the shape of events, reducing the likelihood of a collision and the harm subsequently caused (Crawford & Evans 2012, p.769).

The application of road safety enforcement can be driven ahead as part of the data driven approaches to crime, congestion and traffic safety (DDACCTS) model (Bruce, 2013), effectively single tasking in locations affected by manifold problems. Targeting our responses to the areas of highest risk can, in central London particularly, often see benefit at the same location because of other policing problems. Synthesising analytical products effectively, such as using the CoLCHI, could see a dramatic increase in the efficiency and effectiveness of police enforcement, especially considering the absence of any correlation of previous enforcement to harm articulated in this study. The CoLCHI along with its inspiration the Cambridge CHI provides a new metric, where collisions are not treated equally, where public safety can be analysed and police resources allocated more accurately. The CoLCHI has great potential to shape the future of evidence based policing.

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Appendices

Appendix A Collision Report Booklet and guidance

The Force introduced the current Collision Report Booklets in March 2005. They are in two formats, the existing A6 pocket size and an A4 size for use when convenient. Both are National MG Forms that should be used by every Force and Training School in the Country and contain identical information, but in a different layout. The books were designed to create a standard national format ahead of the provision of an electronic version running on a PDA that should have be available by the end of 2006 and is still promised for some future date.

The books must be used to report all **recordable** collisions. Recordable collisions are those that are **reportable** as per Section 170 Road Traffic Act 1988 (Police National Legal Database ref D3050 refers) and any collision involving a horse or cyclist irrespective of whether a motor vehicle was involved. Appendix B lists which collisions should be recorded.

The information in the booklet is supplied to the Department of Transport and Transport for London who both produce statistics and reports that are used by the Government and Highway Authorities to identify trends, support new or existing legislation, create targets, support the allocation of funds and the implementation of engineering measures. A study for the London area is carried out by 'The London Accident Analysis Unit' who publish detailed reports on particular road safety problems such as the use of mobile phones and HGV interaction with Cyclists. The City of London Corporation, and Transport for London as the two Highway Authorities in the City of London use that information to allocate funding and resources for Road Safety initiatives and highway engineering improvements. The information is also used by this Force as intelligence with regard to identifying the appropriate times and locations for Educational and Enforcement Casualty Reduction and Road Safety initiatives.

🜈 Collision Reporting - Welcome - Home :: Poli	ice, Report, Collision, Accident, Forms, Help, Assis - Micros	oft Internet Explorer p	_ 8 ×
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Collision R	Reporting	Honday	, 16 January 2012
Welcome to Collision Reporting	Log in to the Collision Reporting	j site	
This site has been developed to assist police officers to complete collision reports and statistical forms. The site may also be useful to local and national government officers working in research or road safety.	Authorised Users logging on to this site Code in the fields provided. Authorised I Personnel engaged in Road Safety using Police / Constabul	should enter their Police Force Name an Jsers are Police Officers and Highway Au the site for information and training pur ary	d their PNC thority poses.
Have you been involved in a road traffic accident? Do you want to know how to report it?	Police Force / Con	stabulary PNC Code	
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The Department for Transport have a web page that gives advice on the completion of collision reports at www.collisionreporting.gov.uk

This will take you to a log in page where you will be asked

to fill in two boxes. Police / Constabulary is City of London, and the Police Force /Constabulary PNC Code is 48.

Guidance for Fatal/Life changing injury collisions can be found in the Force public S drive /procedures + guidance/Road Death Investigation/Road Death Investigation Manual.

This document is intended to assist with the completion of the booklet. Most sections are selfexplanatory, with advise being added where it is thought that some technical or other advise might be useful. **N.B.** Reference in the booklets to the term 'Accident' have been at the request of the Department of Transport in relation to the wording in current legislation, but the term 'crash 'or 'collision' should be used by all officers when completing any paperwork or communicating with others.

Page 1. The front page of the booklet contains a number of sections that require basic information relevant to when, where, and who attended.

CAD Reference Number – as a national form there is no place allocated for a CAD number – suggest it is written on the top left hand side of the form.

URN – (Unique Reference Number) the collision report book reference, such as V0423/12 is allocated by the CJU and therefore cannot be entered by the reporting officer.

FATAL/SERIOUS/SLIGHT/NON

INJURY – please circle appropriate word by reference to definition on page 38 sect 3.

1st **& 2nd Road Class & No.** – List of all Classified Roads attached at the end of this document at Appendix A – remaining roads not classified and should be written as such.

O/S House or MP No. - E.g. 182

County or Boor' is 'City of London'

Parish No. or Name does not need to be filled in.

Grid Reference is important to identify exact location, should be the

LLISION Report SERIOUS† DAY	of SL1	RE	PO	RT			
Report SERIOUS†	of SL	RE	PO port	RT			
Report SERIOUS† DAY	of SLI	Re	port	s			
SERIOUS†	SL	OII				† Ci	rcle one
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point of initial impact, and is obtained from the Force Control Room.

Page 2. Contains the details of the drivers/riders and their vehicles, and is repeated at page 5 for a second vehicle.

Non Stop (Contributory) – To be ticked where vehicle is involved but did not collide with another vehicle or person.

Other ID are things that may assist identification such as a Taxi Drivers badge number or the service number of Military personnel.

Test Cert. – Ministry Of Transport Test Certificate.

LGV / PCV Plate No. – The number on the Ministry Plating Certificate which is required by all Large Goods and Passenger Carrying Vehicles. Issued within 14 days of registration or re-issued after testing when vehicle has been modified. Must be displayed inside the cab on a LGV, can be displayed anywhere on a PCV.

MG NCRF/PB C	RESTRICTED	·		Sept. 2004
Vehicle No. e.g. 001, 002, 003	Non Stop (Contribu	tory)	Hit and Run	Parked
*Mr/Mrs /Miss/Ms/Othe Surname/Family Name	r Title			
Forenames			4	
Other ID	D of B			
Address				
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Officer defined ID Code	16+1 ethnicity	code/1	not stated co	de
Tel. No's. (indicate D-Day, E-Eve	e, M-Mobile)			
e-mail				
Registration Mark		Manua	ıl	*YES/NO
		Motor	way	*YES/NO
		L Plate	s	*YES/NO
Make	10	Passer	gers	*YES/NO
Model/cc		Driver	Supervised	*YES/NO
Colour		Trailer		*YES/NO
Use - Business SDP		Test Cer	t. (MOT) Correc	t*YES/NO
LGV / PCV Plate No				
VEHICLE OWNER (IF NC Company/Surname/ or Family Name	OT DRIVER)	*Mr/	Mrs /Miss/M	s/Other Title
Forenames				
Address *(Home/Business)				
	Post C	Code		
Tel. No's. (indicate D-Day, E-Ev	e, M-Mobile)			
e-mail				
and the second se				

RESTRICTED

* Circle as appropriate

Page 3. Contains the initial comments made by the driver, and information as to any injuries sustained and damage to the vehicle, and is repeated at page 6 for a second vehicle.

MG NCRF/PB B1 RESTRICTED Sept. 2004 VEHICLE AND DRIVER INFORMATION DRIVERS INITIAL COMMENTS (if any) Before Caution Time H H M M Drivers Signature CASUALTY DRIVER/RIDER *FATAL / SERIOUS / SLIGHT No. (e.g. 001,002 etc.) Details of Injury (if known) Hospital *Detained / Not Detained Pupil on journey to/from school *YES/NO Relatives informed *YES/NO School Name or No. VEHICLE DAMAGE Description. Indicate areas of damage X Indicate first point of impact Trailer Vehicle removed to: Probable Total Loss *YES/NO Bv: CLE *2/6 *2/7 *2/8 submitted *YES/NO Vehicle defect alleged *YES/NO RESTRICTED * Circle as appropriate 0

Casualty Driver /Rider - Details of Injury. The Severity of a casualty is determined from the observations of the officer at the scene. As our medical training is normally limited to an occasional First Aid Course, a plain language comment of what you can see would be most appropriate unless advised otherwise by a doctor or Ambulance attendance. staff in Assumptions should not be made as to nature of injuries. Include comment made by casualty if appropriate.

Page 38 of the booklet gives guidance on what type of injury is to be recorded as Fatal, Serious, or Slight. **Page 4.** This page is used to record driver/rider and vehicle information, and is repeated at page 7 for a second vehicle.

Preliminary Impairment Test

All drivers should be requested to give a breath test at the scene. No power of arrest for failing to provide if alcohol not suspected.

Eyesight Test

The prescribed "requirement as to eyesight" is to be found in the Motor Vehicles (Driving Licences) Regulations 1999. A driver is required to be able to read a car's number plate at a distance of 20.5 metres in good daylight where the letters or figures are 79 mm in height. For pedestrian controlled vehicles the distance is 12.3 metres. A test can be conducted during the hours of darkness, which if they are unable to read the number plate can be conducted at a later suitable time in daylight.

MGW – Maximum Gross Weight (or Maximum Authorised Mass) as found on Manufacturers Plate or Ministry Plate on Commercial Vehicles.

Tacho / Records of work correct – Drivers should have the last 28 days records with them. Drivers hours on vehicles registered pre 2006 will being recorded onto Tachograph charts. Post 2006 are recorded electronically, and I suggest calling for the assistance of a Traffic Officer.

Goods Vehicle Test Certificate– Required annually after 1st year. This does not have to be in the possession of the driver and production should be requested by HORT/1.

Trailer Test Certificate correct-

This does not have to be in the possession of the driver and production should be requested by HORT/1. However the trailer must be displaying a Trailer Test Date Disc (same size as Vehicle Excise Licence) which gives the Trailer Test expiry date.

Operators Licence Disc Correct – This should be displayed on the vehicle.

Operators Licence No. – The number is on the Operators Licence Identity Disc.

AG NCRF/PB B2 RESTRICT	ED Sept. 2004 R INFORMATION
DRIVING DOC	UMENTS
Driving Licence. No.	*Full / Provisional
and the second	
Insurance Company Certificate. No.	
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Insurance Company Name	
a and an and a second sec	and the second
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Police Station to be produced at	
Docs Required* 1 2 3 4 5	6 7 8 9 10
IMPAIRM	1ENT
Positive BREATH T	Time HHMM
Negative Not prov	ided (medical reasons)
Not applicable Dvr not o	contacted at time of accident
Refused to Provide Not requ	ested - give reason(s)
Preliminary Impairment Test *YES/NO	Eyesight Test *YES/NO
GOODS VEHIC	LE DETAILS
MGW/MAM Tonnes	No. of Axles
Manu /DtP plate correct *YES/NO	Operator Licence Disc
Tacho/Rec of Wk correct *YES/NO	Correct *YES/NO
G V Test Cert correct *YES/NO	Operator Licence No.
Trailer Test Cert correct *YES/NO	na an a
LGV / PCV Plate No	(1,1,1,2) where $(1,1,2)$ is the state of
HORT 1 CO Driving Licence Driving Licence HORT 1 CO Cert of JInsura	DDE f 4 Test 5 GV Platin nce 4 Certificate 5 Test Cert.
6 Cert./Lic. 7 PSV / PCV 8 Docum	eg 9 Seat Belt 10 Other – nent 9 Exemption Specify

RESTRICTED

* Circle as appropriate

LGV/PCV Plate No. – (A repeat request that is also on page 2, but this part of the National Form and cannot be altered locally). The number on the Ministry Plating Certificate which is required by all Large Goods and Passenger Carrying Vehicles. Issued within 14 days of registration or re-issued after testing when vehicle has been modified. Must be displayed inside the cab on a LGV, can be displayed anywhere on a PCV.

Page 8.

This page should be completed by the reporting officer explaining in his/her own words how, in their opinion (at the time of initial completion of the report), the collision occurred.

Should include information about:

Position of vehicles, Marks on the road, Removal of vehicles Offences alleged/apparent Whether Names and Addresses exchanged.

IG NCRF/PB A2	RESTRICTED	Sept. 200
ном	COLLISION OCC	URRED
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This is an initial opinio	h of how the consider occurred	bused upon the injormation
available at the tir	<i>ie which could change in the li</i>	ight of future enquiries
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Page 9.

This and the next 12 pages are to be completed for statistical purposes as required by the Department of Transport. The data is used for a variety of reasons by the Dept. of Transport, and locally by the Highway Engineers and Planners at the Corporation of London and TfL. From the information provided it is possible to identify collision patterns and trends. The majority of the information required is self-explanatory.

Careful completion of these pages will provide information that will enable Highway Engineers, the manufacturers of vehicles, and others, to reduce the incidence of collisions and casualties in the future.

This front sheet need not be completed unless it is intended to separate these pages from the rest of the book, which at present is not Force Policy.

All other greyed – out boxes in the 'Accident Statistics' pages need not be completed as this Force does not separate the Stats from the remainder of the book.

Local Authority Number for the City is 570.

1.3 ACCIDENT F	REFERENCE	Inc. URN
		Other ref.
Acc	ident Sta	tistics
*FATA	L / SERIOUS	/ SLIGHT
1.9 TIME	DAY*	1.7 DATE
HHMM Su M	T W Th F S	DDMM20YY
1st Road Class & No. or (Unclassified - UC) , (Not Known - NK)	1st Road Name	n fan en sen de sen d
O/S House or MP No.	at Junc. with/or	mtrs N S E W *o
2nd Road Class & No. or (Unclassified - UC) , (Not Known - NK)	2nd Road Name	
Town		
County or Borough		
Parish No. or Name		
1.11 Grid Reference E->		NA
1.10 Local Auth' No.(if I	known) Se	ector/Beat No.
Reporting Name		
Number	alter an Maria	BCU/Stn.
Telephone No.		1.2 Force
	11 J	Contraction of the second s

Page 10.

1.5 Number of vehicles and 1.6 Number of casualties - need not be completed unless these pages are to be separated from the rest of the book.

Speed Limit (Permanent)

All the streets in the City of London are subject to a 30 MPH speed limit with the exception of Watling Street and Tower Bridge which have a 20 mph speed limit.

1.5 Number of vehicles		1.20a PEDESTRIAN CROSSII - HUMAN CONTROL	٩G	x
1.6 Number of casualties		None within 50 metres	0	
1.14 ROAD TYPE	161	Control by school crossing patrol	1	
Roundabout	1	Control by other authorised	2	
One way street	2	person		
Dual carriageway	3	CONTRACTOR OF		
Single carriageway	6	1.20b PEDESTRIAN CROSSIN	NG	1429
Slip road	7 🛛 🖓	- PHYSICAL FACILITIE	S	X
Unknown	9	No physical crossing facility within 50m	0	
1.15 Speed Limit (Permanent)	Sector 12	Zebra crossing	1	100-7
1.16 JUNCTION DETAIL	297 1 297 X	Pelican, puffin, toucan or similar non-junction	4	
Not at or within 20 metres of junction	00	Pedestrian phase at traffic	5	0 30 1
Roundabout	01	Footbridge or subway	7	
Mini roundabout	02	Central refuge — no other	8	1.00
T or staggered junction	03	controls		101
Slip road	05	- Hommed -	s where	67
Crossroads	06	1.22 WEATHER		x
Multiple junction	07		r Ast	ŕ
Using private drive or entrance	08	Fine without high winds	1	3.1
Other junction	09	Raining without high winds	2	
Well Long tool - Burt		Snowing without high winds	3	-
JUNCTION ACCIDENTS (ONLY	Fine with high winds	4	ila)
1.17 JUNCTION CONTROL	2213	Raining with high winds	5	1.00
Authorised person	1	 Snowing with high winds 	6	10
Automatic traffic signal	2	Fog or mist — if hazard	7	
Stop sign	3	Other	8	
Give way or uncontrolled	4	Unknown	9	

Pages 11 & 12.

Stats continued.

1.23 ROAD SURFACE CONDI	TION	x	1.24 SPECIAL CONDITIONS		1
Dry	1		None	0	-
Wet / Damp	2		Auto traffic signal out	1	
Snow	3	(7.4	Auto traffic signal partially	2	1.6
Frost / Ice	4	2	defective	10	
Flood (surface water over 3cm deep)	5	0	Permanent road signing or marking defective or obscured	3	12
S CREDEVER M.	11 P.11	1	Roadworks	4	10
			Road surface defective	5	
			Oil or diesel	6	3
		a d	Mud	7	
			1.25 CARRIAGEWAY HAZAR	DS	,
		W an	None A Transform	0	41
1.21 LIGHT CONDITIONS	x	Dislodged vehicle load in carriageway	1		
Daylight: street lights present	1		Other object in carriageway	2	1
Daylight: no street lighting	2		Involvement with previous	3	Ŵ
Daylight: street lighting unknown	3		Pedestrian in carriageway -	6	製作が
Darkness: street lights present and lit	4	W	Any animal in carriageway (except ridden horse)	7	HIC IN
Darkness: street lights present but unlit	5	97 - 1 	1.26 Did a police officer attend	d the	
Darkness: no street lighting	6		scene and obtain the detail this report?	s for	×
Darkness: street lighting	7	5	Yes	1	62
unknown	iquic pos		No	2	4

2221 1122 1122 1122		VE	EH	IC	LE	RECORD						
2.26 VEHICLE REGISTRA	2.6 TOWING AND ARTICULATION X			/EH		E						
Veh 001						No tow or articulation	0	-	12			
Veh 002				Articulated vehicle	1	100		-19	N.			
				Double or multiple trailer	2			101	2			
Veh 003					Caravan	3			1			
Veh 004				Single trailer	4			2.3	1			
		N	/EH	ICI	E	Other tow	5	-	1		1	
2.28 FOREIGN REGISTER	RED	1	2	3	4	2.21 SEX OF DRIVER 🗴	arrie G	10.00		-		
Not foreign registered veh	0	119.2	10793.0	0.00		Male	1					
Foreign reg. veh LHD	1	25.2	12.3	2		Female	2				1	
Foreign reg. vehicle RHD	2				4	Driver not traced	3				Γ	
Foreign reg' vehicle-two wheeler	3		3.5	in the	195	2.22 AGE OF DRIVER (Fs	tima	ate i	fneo	PSS	arv	
2.5 TYPE OF VEHICLE	x								Thee			
						Vehicle 001 Vehicle 002						
Pedal cycle M/cycle 50cc and under M/cycle over 50cc and up	01	124		1.64	-	Vehicle 003 Vehi	cle 00	04				
	02	1	100		-							
to 125cc	00	1.54	100	1013	Ľ.,	2.27 DRIVER HOME POS	TCC	DDE	1			
M/cycle over 125cc and up to 500cc	04	25.8	150		10	or Code: 1- Unknown Resident 3 - Parked	n 2- & ur	No	n Ul ende	K	1	
Motorcycle over 500cc	05	10	1 all	1.5	1	annanisi dankan katilan takting	10000	1000	-		-	
Taxi / Private hire car	08	162	A LE	a he	121	Veh 001						
Car	09		13	-		Vab 002		1010			0	
Minibus (8-16 passenger	10	1	19.	1		ven ooz					16	
Bus or coach (17 or more	11			-	-	Veh 003						
passenger seats)		n.	100	15		Vab 004					joj	
Other motor vehicle	14	198	1.1	1		VCITOOP		ALC: N				
Other non-motor vehicle	15		12	1	-	2 22 REEATLY TEST X			1	1		
Ridden horse	16			12	1	2.25 DREATH TEST	inger i	1	1	1200		
Agricultural vehicle (include diggers etc)	17	12.	113	2	1	Not applicable	0					
Tram / Light rail	18		1000	186		Positive	1					
Goods vehicle 3.5 tonnes	19		1		1	Negative	2					
mgw and under						Not requested	3	1				
Goods vehicle over	20					Refused to provide	4					
3.5 tonnes mgw and under						Driver not contacted at	5			100		
Coods vehicle 7.5 toppes	21	+	+	+	+	Not provided	6	1.23	-	-	+	
Goods venucie 7.5 tofules	1 21			1	1	(medical reasons)	0					

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Pages 13 & 14.

Stats continued.

	vi	H	IC	LE	RECORD Supt. 2034
	\	/EH	ICI	E.	2.10 JUNCTION LOCATION VEHICLE
	1	2	3	4	OF VEHICLE X 1 2 3 4
0		L		L	Not at or within 20m of 0 junction
1					Approaching junction or 1
2					waiting/parked at junction approach
				_	Cleared junction or waiting/ 2 parked at junction exit
EOF					Leaving roundabout 3
	_	_	_	_	Entering roundabout 4
1					Leaving main road 5
2				П	Entering main road 6
3				Н	Entering from slip road 7
	L			Ц	Mid junction – on r'bout 8 or on main road
4	┝		┝	Н	2.7 MANOEUVRES X
Б					Reversing (1
					Parked (7
N A LICTI	T TI ED I	ME LAN	OF IE/		Waiting to go ahead 00 but held up
107	ai.	<u>^</u>	_	_	Slowing or stopping 04
00					Moving off 05
01	⊢	⊢	⊢	H	U turn 06
02	⊢	⊢	⊢	H	Ministry for the term laft
0G	⊢		⊢	H	Turning to turn ten US
					Waiting to turn right 10
04					Changing lane to left 11
	-	-	⊢	Н	Changing lane to right 12
05	L				
05					Overtaking moving 13 vehicle on its offside
05					Overtaking moving vehicle on its offside Overtaking stationary 14
05 06 07					Overtaking moving vehicle on its offside Overtaking stationary vehicle on its offside Overtaking on nearside
05 06 07					Overtaking moving vehicle on its offside Overtaking stationary vehicle on its offside Overtaking on nearside Overtaking on nearside Going ahead left hand bend 16
05 06 07 08					Overtaking moving vehicle on its offside Overtaking stationary vehicle on its offside Overtaking on nearside Overtaking on nearside Going ahead left hand bend Going ahead left hand bend Going ahead left hand bend I7
	0 1 2 E OF 1 2 3 4 5 00 01 02 03 04	VI 1 2 2 2 3 4 5 1 2 3 4 5 0 0 0 0 0 0 0 0 0 0 0 0 0	VEH VEH 1 2 0 0 1 2 2 0 2 0 2 0 2 0 3 0 4 0 5 0 0 0 0 0 0 0 0 0 0 0 0 0 0	VEHIC VEHICI 1 2 3 0 1 2 3 1 2 3 0 1 2 3 1 3 3 1 3 3 1 3 3 1 3 3 1 4 3 1 5 5 1 3 1 5 1 5 1 5 1 5 1 5 1 5 1 5 1 5	VEHICLE 1 2 3 4 0 0 0 0 1 2 3 4 0 0 0 1 2 3 4 0 0 1 2 0 0 1 0 0 2 0 0 1 0 1

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2.11 SKIDDING AND		1	/EH	IICL	E	2.14 FIRST OBJECT HIT OFF			VEHICL			
OVERTURNING X	1.M:	1	2	3	4	CARRIAGEWAY X		1	2	3	T	
No skidding, jack-knifing or overturning	0	1 1977 1			10.00	None	00	s fa	n li	北京	k	
Skidded	1	1.1	1	1526		Road sign / Traffic signal	01		1.11	1. it		
Skidded and overturned	2		239	100		Lamp post	02		1		L	
Jack-knifed	3		100	1		Telegraph pole /	03					
Jack-knifed and overturned	4		12.2	÷.,		The currently pole	-	-	-		+	
Overturned	5	1.00	1.00	1.0		Tree	04	-	-			
		CE				Bus stop / Bus shelter	05		1	-		
2.12 HIT OBJECT IN CAL	KIA	GE	WA	~		Central crash barrier	06	1.10	-	10		
None	00	No.	-	. inte	1	Nearside or offside crash	07	1		1.1		
Previous accident	01	interest	ULIG	10.22	1	barrier	24	1.6	100			
Roadworks	02		2	-	-13	Submerged in water	08	and the		11B		
Parked vehicle	04	the state	2.0	1		Entored ditab	00	-		-		
Bridge-roof	05		1.4			Entered ditch	09	-	1	1	-	
Bridge-side	06	2		1		Other permanent object	10	2.5				
Bollard / Refuge	07							1185		225		
Open door of vehicle	08	11		1.44	33	2.16 FIRST POINT OF IMPACT			1			
Central island of r'bout	09	11	-21	1	11							
Kerb	10	12.1	13		10.1	Did not impact	0		: m			
Other object	11	1				Front	1			1	1	
Any animal (except ridden horse)	12	1				Back	2		18.	1		
A CONTRACT OF	12 -		100			Offside	3			100	Ċ	
2.13 VEHICLE LEAVING	CAR	RIA	GE	WAY	X	Nearside	4	13		122	f	
Did not leave carriageway	0	tet e	1. 194	1.10	1	I TRACESSON &	1		166	d'air	(i)	
Left carriageway nearside	1		ata:	di.		2.17 FIPST CONITACT BE	TIATE	ENI	2.7		1	
Left carriageway nearside and rebounded	2	di		i al		EACH VEHICLE Example: In a 3 car collision	on veh	icle 1	coll	ides		
Left carriageway straight ahead at junction	3			1999		with the rear of vehicle 2 I	oushin	g it i	nto v	/ehic	e 3	
Left carriageway offside	4		1248	- 5-2	24	Example Code:		. [1	111	
Left carriageway offside	5	-	1	100		Vehicle 001 first collides with veh	icle 00	2	0	0	2	
onto central reservation and rebounded		1	itin 1275	244		Vehicle 002 first collides with veh Vehicle 003 first collides with veh	icle 00	1	0	0	1	
Left c'way offside and crossed central reservation	6	- 24	iste de	10								
Left carriageway offside	7	-				Ven 001 Veh (02				3	
Left carriageway offside	8	5.0	18 1	130	1	Veh 003 0 Veh 0	004	0		Γ	1	

ject to local directions, boxes with a grey background need not be completed if already recorded UNCLASSIFIED 4.4

Pages 15 & 16.

Stats continued.



MG NSRF/PB C2 CASUALTY RECORD (PEDESTRIAN CASUALTIES ONLY) CASUALTY 3.10 PEDESTRIAN LOCATION X 2 3 4 5 1 6 01 In carriageway, crossing on pedestrian crossing facility 02 In c'way, crossing within zig-zag lines at crossing approach 03 In carriageway, crossing within zig-zag lines at crossing exit In c'way, crossing elsewhere within 50m of pedestrian crossing 04 In carriageway, crossing elsewhere 05 06 On footway or verge On refuge, central island or central reservation 07 08 In centre of c'way, not on refuge, island or central reservation 09 In carriageway, not crossing 10 Unknown or other 3.11 PEDESTRIAN MOVEMENT X 1 Crossing from driver's nearside Crossing from driver's nearside-masked by parked or 2 stationary vehicle 3 Crossing from driver's offside Crossing from driver's offside-masked by parked or 4 stationary vehicle 5 In carriageway, stationary - not crossing (standing or playing) In carriageway, stationary -not crossing (standing or playing), masked by parked or stationary vehicle 6 Walking along in carriageway-facing traffic 7 Walking along in carriageway-back to traffic 8 9 Unknown or other 3.12 PEDESTRIAN DIRECTION X 3.19 PEDESTRIAN INJURED IN THE COURSE OF 'On The Road' WORK CASUALTY Work actively carried out on public road 2 3 4 5 6 (e.g. delivery services, road maintenance, postal delivery, traffic control etc.) X Standing still 0 N bound 1 CASUALTY NE bound 2 5 2 3 4 6 1 E bound 3 SE bound 4 No 0 5 S bound Yes 1 SW bound 6 2 Not known W bound 7 8 NW bound Unknown 9 UNCLASSIFIED

Sept. 2004

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Page 17, 18 & 19.

Page 17 requests information that is completed from the list on the following two pages. Do not complete purely on the comments made by the reporting/involved persons, but on your opinion.

MG NSRF/PB D1

CONTRIBUTORY FACTORS

Sept. 2004

- 1. Select up to six factors from the grid overleaf, relevant to the accident.
- Select up to six factors from the grid overlear, relevant to the accident.
 Factors may be shown in any order, but an indication must be given of whether each factor is very likely (A) or possible (B).
 Only include factors that you consider contributed to the accident. (i.e. do NOT include "Poor road surface" unless relevant).

- 4. More than one factor may, if appropriate, be related to the same road user.
- 5. The same factor may be related to more than one road user. The participant should be identified by the relevant vehicle or casualty ref no. (e.g. 001, 002 etc.), preceded by "V" if the factor applies to a vehicle, driver/rider or the road environment (e.g. V002), or "C" if the factor relates to a pedestrian or passenger casualty (e.g. C001).
 Enter U000 if the factor relates to an uninjured pedestrian.

	1st	2nd	3rd
Factor in the accident			
Which participant? (e.g. V001, C001, U000)			
Very likely (A) or Possible (B)	ale . Den .		
	4th	5th	6th
Factor in the accident	nine of the second		
Which participant? (e.g. V001, C001, U000)			
Very likely (A) or Possible (B)	igrang of set		
	and the second		

(Note: Only use if another factor contributed to the accident and include it in the text description of how the accident occurred)

These factors reflect the reporting officer's opinion at the time of reporting

	109	108	107	106	105						
APRIX I	Animal or object in carriageway	Road layout (e.g. bend, hill, narrow carriageway)	Temporary road layout (e.g. contraflow)	Traffic calming (e.g. speed cushions, road humps, chicanes)	Defective traffic signals						
				206	205						
atery bolt	.219			Overloaded or poorly loaded vehicle or trailer	Defective or missing mirrors						
310	309	308	307	306	305						
Cyclist entering road from pavement	Vehicle travelling along pavement	eeding ed limit Travelling too fast for conditions Following travelling too close along pavemen									
410	409	408	407	406	405						
Loss of control	Swerved	Sudden braking	Passing too close to cyclist, horse rider or pedestrian	ailed to look roperly Failed to judge other person's path or speed			Failed to judge other person's path or speed pedestrian				
510	509	508	507	506	505						
Distraction outside vehicle	Distraction in vehicle	Driver using mobile phone	Cyclist wearing dark clothing at night	Not displaying lights at night or in poor visibility	Illness or l disability, mental or physical						
			607	606	605						
	ulg(out) ou		Unfamiliar with model of vehicle	Inexperience of driving on the left	Learner or inexperienced driver/rider						
710	709	708	707	706	705						
Vehicle blind spot	Visor or windscreen dirty or scratched	Spray from other vehicles	Rain, sleet, snow or fog	Dazzling Dazzling neadlights sun				Pazzling Dazzling Rain, sle sadlights sun snow or			
810	809	808	807	806	805						
Disability or illness, mental or physical	Pedestrian wearing dark clothing at night	Careless, reckless or in a hurry	Impaired by drugs (illicit or medicinal)	Impaired by alcohol	Dangerous action in carriageway (e.g. playing)						
*999				The second second	0						
Other – Please specify below	vote tane - cle stop box i	antona i		و میرانم. و	Inveload in at (lotation						

12		101	102	104		
	Road Environment Contributed	Poor or defective road surface	Deposit on road (e.g. oil, mud, chippings)	Slippery road (due to weather)	Inadequate or masked signs or road markings	
		201	202	203	204	
	Vehicle Defects	Tyres illegal, defective or under-inflated	Defective lights or indicators	Defective brakes	Defective steering or suspension	
15)		301	302	303	304	
ouse mude	Injudicious Action	Disobeyed automatic traffic signal	Disobeyed 'Give Way' or 'Stop' sign or markings	Disobeyed double white lines	Disobeyed pedestrian crossing facility	
	D . (D.1	401	404			
Aries alle	Error or Reaction	Junction overshoot	Junction restart (moving off at junction)	Poor turn or manoeuvre	Failed to signal or misleading signal	
		501	502	503	504	
122 1 240	Impairment or Distraction	Impaired by alcohol	Impaired by drugs (illicit or medicinal)	Fatigue	Uncorrected, defective eyesight	
L L L L		601	602	603	604	
UILLY VII	or Inexperience	Aggressive driving	Careless, reckless or in a hurry	Nervous, uncertain or panic	Driving too slow for conditions or slow vehicle (e.g. tractor)	
ncı		701	703	704		
	Vision Affected by	Stationary or parked vehicle(s)	Vegetation	Road layout (e.g. bend, winding road, hill crest)	Buildings, road signs, street furniture	
	Radastrian Only	801	802	803	804	
	(Casualty or Uninjured)	Crossing road masked by stationary or parked vehicle	Failed to look properly	Failed to judge vehicle's path or speed	Wrong use of pedestrian crossing facility	
-		901	902	903	904	
	Special Codes	Stolen vehicle	Vehicle in course of crime	Emergency vehicle on a call	Vehicle door opened or closed negligently	

Page 20. This page is used to collect Local Stats that are not collected nationally but are particularly relevant to the City of London.

The lack of use of seatbelts, particularly by passengers and delivery drivers, has resulted in casualties that could be avoided. This information is used to justify enforcement and educational campaigns and to bring the matter to the attention of relevant bodies and organisations.

Taxis and Private Hire Vehicles make up a high proportion of the traffic in the City of London, and issues about the safety of them are passed to the Public Carriage Office and other organisations.

Cyclists now make up the largest single group of those that are killed or seriously injured on the City's roads. Numerous cycle lane facilities have been placed across the City as part of the London Cycle Network and other initiatives, and whilst supported by most, some have been a major contributor towards creating the circumstances where collisions will occur. This box is intended to provide information to identify those cycle MG NSRF/PB E Sept. 2004 LOCAL STATISTICS SAFETY BELT USAGE (IF DRIVER OR CASULTY PASSENGER CASULTY) 2 3 4 5 6 1 Caualty not in vehicle. 0 Safety belt in use. 1 Safety belt not in use. 2 3 Safety belt not fitted. 4 *Child safety belt/harness fitted in use. *Child safety belt/harness fitted not in use. 5 *Child safety belt/harness not fitted. 6 Unknown 7 TAXI/PRIVATE HIRE VEHICLE VEHICLE 1 2 3 4 Not Taxi or Private Hire Vehicle. 0 Licensed Taxi. 1 Licensed Private Hire Vehicle. 2 Unlicensed Private Hire Vehicle. 3 Police Special Projects Code. CYCLING FACILITIES AY SCENE OF COLLISION No cycle facility Advisory Cycle lane Mandatory Cycle lane Advanced Cycle stop box at junction Bus Lane permitting cyclists

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facilities that promote safer cycling in the City, and those that do not.

Pages 21/22/23.

ľ

These pages, including a continuation page, are to record an interview at the scene. Another book should be used if a second driver interview is required.

MG NCRF/PB H1 RECO	RESTRICTED	Sept. 2004	MG NCRF/PB H2	RESTRICTED	Sept. 200
Veh	nicle No. e.g. 001, 002, 003				and The constraints of the
*Mr/Mrs /Miss/Ms/ Surname/Family Nam	Other Title ne		KEPLY	NY CASTIALITY Compl REAST ALEY	PRIDESTED
Forenames			Compile to A		SSEMUM
and an and a second second second second	Date of Birth DDMMY	Y Y Y		Miles (partesty, antativit, age styling and a styling and	OWNER (C
Address		nan on Dhanna ay in	oldi udaciveti ya	eine - canin Mamo	A fee
	Post Code				-1492) T
Place of Interview	na nana a farmanan ang na manganan ang nanganan				
Person(s) Present		· · · · · · · · · · · · · · · · · · ·			
Time/Date Commence	ed				
Time/Date Concluded	I				
"You do not have to sa not mention when que Anything you do say r	y anything but it may harm your del stioned something which you later re nay be given in evidence."	fence if you do ely on in Court.	i upit de treute s	i George States States States States States States	
REPLY					Treases
"I also have to tell you to leave if you wish to	that you are not under arrest and the	at you are free	nes lant re-	and had the second second second	TI paigting
REPLY			C. GRANESSI IN	vehicle bet by e.g. 001	thailw -
"I am		"	OWNER Samo	And Court TREASCH NGT Con	Willing by
"Were you the driver o	of a			Aller and a second s	Initial Corr
Registration number			Contraction of the second second	and and a second s	
involved in a collision	at(time) on(d	ate)		an a part of a contrast of an internal Markets and a second	
at (location)	, , , , , , , , , , , , , , , , , , ,		Signature	na in the second second from a second sec	
REPLY		?"	Signature of Interv	iewing Officer	
	BECTBIOTES				And the state of the

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Pages 24 &25, repeated on pages 26-31.

These pages are for the recording of casualty details other than the drivers or riders of motor vehicles who are recorded earlier in at pages 2-7. Section C is for recording damage to property other than motor vehicles.

INDICATE CATEGORY	x	Initial Comments (cont)
PEDESTRIAN CASUALTY Complete A and B		
PASSENGER CASUALTY Complete A and B		
WITNESS Complete A		
OWNER (Other property/animal) Complete A and C		
OTHER PERSON INVOLVED Complete A	13.3	
A Surname/Family Name *Mr/Mrs /Miss/Ms/Other *	Title	Signed
Forenames		B CASUALTY No. (e.g. 001,002 etc) *FATAL/SERIOUS/SLIGHT
Date of Birth D D M M Y Y Y	Y	Details of Injuries
Difficer defined ID Code 16+1 ethnicity code/not stated code Address (Home/Business) Post Code Fel. No's. (indicate D-Day, E-Eve, M-Mobile)		Hospital *Detained / Not Detained Pupil on journey to/from school *YES/NO Relatives informed *YES/NO School Name or No.
f passenger in Veh. No. e.g. 001 Seat possition *Front/Re - which vehicle hit by e.g. 001 Independent *YES/NO	ear	C DETAILS OF OTHER OWNER INFORMED *YES/NO PROPERTY DAMAGED By
Willing to attend Court *YES/NO MG11 Completed*YES/1	NO	Old the second of the second s
nitial Comments	ircoff?	Titui Continer Is

ID Code and 16+1 ethnicity codes can be found on page 37.

Pages 32& 33.

A simple sketch map showing the road layout, road names, and apparent point of impact, position and direction of the vehicles is required for all collisions resulting in personal injury. It is important to record any marks left on the road as a result of the collision.



Page 34 & 35.

The pages for additional notes include details of:

This needs to be only known facts and not opinions.

Ambulance arrival time, Ambulance departure time, Ambulance Station and running number,

Any follow up enquiries with Hospitals, relatives etc.

Include confirmation of injuries when ascertained.

Hackney Carriage driver and vehicle plate numbers.

Private Hire driver badge and vehicle Plate Numbers.

PCV running number.

It is also the place to record additional information not relevant to any other section book.



should

Page 36.

This page is to be used by reporting and supervising officer to make comments with regard to suggested further action to be taken.

P
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Page 37 & 38.

These two pages provide information to assist with the completion of the booklet.

All reports should be checked and signed by a Supervisor.

MG NC	RF/PB G1	TY CODES	Sept. 2004	MG	NCRF/ PB G2	RESTRICTED	Sept. 2004				
	ETHNIC	TT CODEC	an white states and the states of the states		CONTAI	NOTES AND INSTRUCTIONS	3-11-30125				
	Self-classific	ation 16+1	<u>Codes</u>	1.	This report (Form MC	G NCRF) will be used for the recording of Ro	ad Traffic Collisions				
A1	Asian Indian	M1 Whit M2 Whit	te and Black Caribbean te and Black Africa	 The statistics pages (Form MG NSRF) MUST be completed in all collisions occurring or the Highway resulting in any Personal Injury, however minor. They are not required to submitted, and need not, unless required by local instructions, be completed in collision resulting in Damage Only. 							
A2 A3 A9	Asian Bangladeshi Any other Asian background	Yakistani M2 Write and Diack Africa Bangladeshi M3 White and Asian her Asian background M9 Any other mixed backgrou			For statistical purposes a Highway is a road to which all, or some classes, of have unrestricted right of access including toll roads and bridges (e.g. M6 T River Severn Bridge). Statistics pages should not be completed for collision						
B1	Black Caribbean	W1 Whi	te British	3.	This report must indi Injury or in Damage than 30 days as a resu	cate whether the collision resulted in either Only. A collision will be classified as Fatal w It of the collision and other than through na	Fatal, Serious or Slight where death occurs in less atural causes or suicide.				
B 2	Black African	W2 Whi	te Irish		A collision will be cla	assified as Serious when, for example any of	the following apply:				
B9 01	Any other Black background	W9 Any O9 Any	other White background		Any fracture Internal injury Severe cuts Crushing	Burns (excluding friction burns) Severe general shock requiring hospital tr Detention in hospital as an in-patient (imr Fatal injuries where death occurs 30 or mo	ospital treatment tient (immediate or later) 30 or more days after the collisior				
	No ANT TO A CONTRACT SHEEP WAA	A REAL PROPERTY OF A	and more than the second		A collision will be cla including for example	assified as Slight where any other injury occ e:	urs however minor				
	Officer define	d Phoenix	Codes		Bruises Slight cuts	Slight sprains including neck whiplash in Slight shock requiring roadside treatment	jury				
- 18. 19. 19.	1 White I 2 Dark Fi	European	nasia na mana na mana nasia na Uto muno na itu na dana na mana na itu	4.	Accidents on a 'highy injury occurs will be completed even thou	way' involving pedal cyclists and or ridden h reported as Road Traffic Collisions and Coll gh there may be no motor vehicle involved.	orses where personal ision Statistics will be				
la st	3 Afro Ca	ribbean	Contract of the second se	5.	Form V23 (Notification	on of a vehicle likely to be a total loss) will g ously damaged vehicle is a police vehicle.	ill <u>only</u> be submitted by 2.				
1 1.45	4 Asian		the approximation of the second se	6.	to breath test a driver						
	5 Orienta	1 American Balant	lei wit net som benämnigen.		who is a patient and	seeking to establish that the doctor in imme-	diate charge has no				
E.	6 Arab		Strated Paradon (2, 2015		"I propose to require	a specimen of breath from this person. In orde	r to do so I propose to				
1	0 Unknown Solf classification Not Stated Codes				give this person a way prosecution. Have you breath, to the warning A preliminary breath investigation at a hos for such an offence.	rring into failure to produe ine specimen may u any objection to the requirement being mada g being given or to the specimen being provide t test is not an essential prerequisite for a sec spital. While a person is a patient at hospital	e for the specimen of ed?" tion 3A, 4 or 5 RTA 1988 he may not be arrested				
1.9	on to the state that an a solite to got be	wided for the type	en ei met Hijk wert & seiten	7.	Ethnicity: Provision i	is made as a part of each driver's details for t	the recording of two				
	N1 Decline	ed seed views is the e	naine näi säelleskäneiselestellä 19 laikuus ja kurin annaassi		codes. A two digit bo Self-classification lis	t below or a code from the third 'Not Stated'	list below covering				
112.	N2 Didn't	understand	a ender tryin the Althouse led		reasons why a driver	did not self-classify. A single digit box is pr cer-defined PNC/Phoenix list below.	ovided for recording				
	N3 Called	away	the set from the set of the set o		a coue nom me Onn	2120(T 500)5) PS					
1.0	N4 Public	Order	The second in the second in the second se	1	Report						
1.275	N5 Regina	or Business Vic	tim		Checked by	Nº Ratic order	Signature				
	and the second sec	$\begin{array}{cccc} & & & & \\ & & & & \\ & & & & \\ & & & & $	2012/11/2012/11/2012/11	-	Date / Time	/					
				L	and the second	RESTRICTED					

VAR	b Dat	Time	e Day	Location 1	Location 2	Type of Acciden	t LAAU Record	CP No Transport Moo	e Casualty No	os Severity of Injury	Causation Factor	Ву	Self reporting form	Taxi or PHV	Grid Reference Easting	Grid Reference North	Summery
0/0191/	11 03/04/2	011 23:5	0 Sunday	GREAT TOWER STREET	BYWARD STREET	Sight hjury	Slight	111/11 Bicycle		1 Slight	Opening door of a vehicle	Car	FALSE		533300	180710	VEHICLE 1 TRAVELLING TOWARDS TOWER HILL, DRIVER OF VEHICLE 2 OPENED DOOR KNOCKING RDER OF VEHICLE 1.
																	VEHCLES 1 AND 2 TRAVELLING WEST BOUND IN LANE 1. VEHICLE 1 IN TRAFFIC WENT TO OVERTAKE VEHICLE 2 AT
																	FAIRLY SLOW SPEED. VEHICLE 2 MOVED INTO VEHICLE 1'S PATH, CAUSING RIDER OF VEHICLE 1 TO CATCH RIDER OF
0/0169	1 04/04/	011 07:3	5 Monday	UPPER THAMES STREET	LAMBETHHILL	Slight Injury	Not recorded	/ 0 Motor Cycle		1 Slight	Changing Lane	Bicycle	FALSE		532190	180850	VEHICLE 2, CAUSING RIDER TO FALL OFF.
																	VEHICLES 1 AND 2 TRAVELLING WEST BOUND IN LANE 1. VEHICLE 1 IN TRAFFIC WENT TO OVERTAKE VEHICLE 2 AT
																	FAIRLY SLOW SPEED. VEHICLE 2 MOVED INTO VEHICLE 1'S PATH, CAUSING RIDER OF VEHICLE 1 TO CATCH RIDER OF
0/0169	11 04/04/2	011 07:3	5 Monday	UPPER THAMES STREET	LAMBETH HILL	Slight Injury	Not recorded	/ 0 Bicycle		1 Slight	Changing Lane	Bicycle	FALSE		532190	180850	VEHICLE 2, CAUSING RIDER TO FALL OFF.
																	VENCLE 1 STOPPED TO WAIT FOR GREEN LIGHT, THEN HEADED TOWARDS HIGH HOLBORN, SAW VENCLE 2 ENTER FROM
																	NEW FETTER LANE, VEHICLE 2 THEN COLLIDED WITH VEHICLE 1 CAUSING RIDER TO FALL OFF AND SUSTAIN INJURY.
0/0204	1 04/04/2	011 07:1	5 Monday	HOLBORN CIRCUS	NEW FETTER LANE	Serious Injury	Serious	113/11 Bicycle		1 Serious	Turning Right	Bicycle	FALSE		531390	181550	DRIVER OF VEHICLE 2 FAILED TO STOP
																	VENCLE 1 CYCLING ALONG AV A MARIA LANE, TOWARDS THE JUNCTION WITH LUDGATE HILL. VENCLE 1 INTENDED TO
0/0230	11 06/04/2	011 17:4	0 Wednesday	AVEMARIA LANE	LUDGATEHILL	Slight Injury	Slight	123/11 Bicycle		1 Slight	Overtaking	Motor Cycle	FALSE		531880	181130	TURN RIGHT, VEHICLE2 OVERTOOK STATIONARY BUS AND COLLIDED WITH VEHICLE1.
																	VENCLE 1 TRAVELLING WEST ON CHEAPSIDE, INDICATING TO TO TURN SOUTH INTO NEW CHANGE AS IT TURNED
																	VENCLE 2-ALSO TRAVELLING WEST ON CHEAPSIDE BUT INTENDING TO CONTINUE STRAIGHT ON - PASSED BY THE
0/0167/	11 06/04/2	011 09:5	0 Wednesday	NEW CHANGE	CHEAPSIDE	Slight Injury	Not recorded	10			Overtaking - Nearside	Bicycle	FALSE		532130	181230	NEARSIDE OF VEHICLE 1. CONTACT BETWEEN THE 2 VEHICLES WAS
																	VEHICLE 1 TRAVELLING WEST IN TOWER HILL IN LANE 1, VEHICLE 2 TRAVELLING WEST IN LANE 2 (OUTSIDE). VEHICLE 1
																	TURNED RIGHT INTO TRINTY SQUARE ACROSS THE PATH OF VEHICLE 2. DAMAGE CAUSED TO BOTH VEHICLES AND
0/0180	1 08/04/2	011 09:2	5 Friday	TOWER HILL	TRINTY SQUARE	Serious Injury	Not recorded	/ 0 Motor Cycle		1 Serious	Turning Right	Car	FALSE		533450	180750	RIDER OF VEHICLE 2 SUSTAINED SERIOUS INJURY
																	VENCLE 2 WAS TRAVELLING EASTBOUND IN LANE 1 OF 2 ON VICTORIA EMBANYMENT ENTERING BLACKFRIARS
				BLACKFRIARS													UNDERPASS. VEHICLE 1 WAS ALSO IN LANE 1 OF 2 TRAVELLING BEHIND VEHICLE 2. VEHICLE 1 OVERTAKES VEHICLE 2,
0/0184	1 09/04/2	011 12:1	6 Saturday	UNDERPASS	VICTORIA EMBANKMENT	Slight Injury	Slight	109/11 Bicycle		1 Slight	Changing Lane	Goods/HGV	FALSE		531680	180820	AND ON RETURNING TO LANE 1, VEHICLE 1 CLIPS VEHICLE 2 CA
																	CASUALTY 1 CROSSED ROAD FROM SOUTH TO NORTH. VEHICLE 1 TRAVELLING WEST TO EAST IN LEADENHALL
0/0223	11 10/04/2	011 22:0	5 Sunday	LEADENHALL STREET	FENCHURCH STREET	Slight Injury	Slight	121/11 Pedestrian		1 Slight	Drink	Pedestrian	FALSE		533450	181120	STREET, AND COLLIDED WITH CASUALTY 1 IN MIDDLE OF ROAD
																	CASUALTY 1 CROSSED ROAD FROM SOUTH TO NORTH. VEHICLE 1 TRAVELLING WEST TO EAST IN LEADENHALL
0/0223	11 10/04/2	011 22:0	5 Sunday	LEADENHALL STREET	FENCHURCH STREET	Slight Injury	Slight	121/11 Car		1 Slight	Drink	Pedestrian	FALSE		533450	181120	STREET, AND COLLIDED WITH CASUALTY 1 IN MIDDLE OF ROAD
																	VENCLE 1 TRAVELLING NORTH ON MINORIES TOWARDS JUNCTION WITH GOODMANS YARD, FAILS TO NEGOTIATE
																	RIGHT HAND BEND, LEAVING THE ROAD TO THE NEARSIDE AND COLLIDES HEAVILY WITH CCTV POLE AND TRAFFIC
0/0176	10/04/2	011 05:2	5 Sunday	MINORIES	GOODMANS YARD	Serious Injury	Serious	104/11 Car		1 Serious	Loss of control	Car	FALSE		533670	180890	LIGHT. DRIVER RECEIVES SERIOUS LEG AND CHEST INJURIES. FAILS B

Appendix B Example of Injury Collision Data Capture
Appendix C Key to Enforcement Locations

Location by Intersection	Alpha		
Bishopsgate Between Camomile South			
East Area Aldgate High Street	В		
East Area Aldgate High Street Fenchurch St And Leadenhall St	С		
East Area East cheap_ JW _London Bridge	D		
Gracechurch Street Bishopsgate	E		
King St Cheapside Poultry	F		
Millennium Bridge	G		
Moorgate Monitoring Road Works	Н		
North Area Beech Street _JW_ Aldersgate Street	I		
North Area Bishopsgate Middlesex Street	J		
North area Gresham Street _JW King Street	К		
North Area South Place _JW _Moorgate			
North Area Wormwood Street _JW _Bishopsgate			
Poultry	N		
South Area Cannon Street Monitoring Road Works	0		
South Area Upper Thames Street Between Broken Wharf And			
Southwark Bridge	Р		
South Area Upper Thames Street Southwark Bridge	Q		
St Pauls Cathedral Public High walks	R		
West Area Farringdon Street	S		
West Area Fleet St _JW_ Ludgate Circus	Т		
West Area Fleet Street _JW _Fetter Lane	U		
West Area Holborn Circus	V		

Appendix D Example of Proximal CoLCHI formula in Excel Enforcement site A

Grid_Refe	Grid_Refe	Summary	LAAU_Rec Near_Enfo	Location_	Date_Scor	LAAU_Cos	Total_Scor
533250	181130	VEH 1 (HGV) PARKED AND PASSENGERS OPENS THEIR DOOR WHICH COLLIDES WITH CAS 1 HEAD.	2 North are	0.5	0.2	191462	19146.2
533300	181130	VEH 1 (CAR) E/B ON LEADENALL LETS A CAR EXIT SECOND STREET AND WHILE TURNING INTO THE SECOND STREET COLLIDIES WI	1 East Area	0.5	0.2	14760	1476
533040	181110	VEH 1 (P/C) S/B AND STATIONARY AT RED ATS WHEN LIGHTS CHANGE VEH 1 MOVES OFF SLOWLY AND VEH 2 (BUS) SOUND ITS H	1 Gracechur	0.25	0.2	14760	738
533130	181320	LORRY PARKED AND OPENED DRIVERS DOOR INTO CARRIAGEWAY AS CYCLIST WAS PASSING CAUSING HIM TO FALL By St Heler	1 North are	0.5	0.3	14760	2214
533330	181340	VEH 1 (BUS) TRAVELLING W/B WHEN VEH 2 (CAR) PULLS OUT OF ST MARY AXE, HEADING WRONG WAY DOWN ONE WAY STREET	1 North are	0.25	0.3	14760	1107
533330	181340	VEHICLE 1 PULLED UP TO JUNCTION, WAS THEN HIT BY BEHIND BY VEHICLE 2	1 North are	0.25	0.4	14760	1476
533140	181340	VEHICLE 1 BRAKED SUDDENLY - REASON UNKNOWN. SELF REPORT FORM	1 North are	0.5	0.4	14760	2952
533080	181240	VEHICLE 1 FRONT WHEEL WENT INTO 10INCH DEEP POTHOLE IN BISHOPSGATE, CAUSING RIDER TO FALL OFF.	1 Gracechur	0.5	0.4	14760	2952
533070	181130	VEHICLE 1 TRAVELLING EAST ON LEADENHALL STREET, CASUALTY 1 STEPPED OUT INTO THE ROAD WITHOUT CHECKING	2 Gracechur	0.25	0.5	191462	23932.75
533020	181120	VEHICLE 1 TRAVELLING ALONG CORNHILL , PEDESTRIAN STEPPED OUT IN FRONT OF THE VEHICLE CAUSING IT TO BRAKE SUDDEN	1 Gracechur	0.25	0.6	14760	2214
533050	181210	CASUALTY 1 RAN ACROSS ROAD AND COLLIDED WITH VEHICLE 1. VEHICLE 2 BRAKED HEAVY AND VEHICLE 3 BRAKED BUT COLLID	1 Gracechur	0.5	0.7	14760	5166
533050	181210	CASUALTY 1 RAN ACROSS ROAD AND COLLIDED WITH VEHICLE 1. VEHICLE 2 BRAKED HEAVY AND VEHICLE 3 BRAKED BUT COLLID	1 Gracechur	0.5	0.7	14760	5166
533050	181210	VEHICLE 1 TRAVELLING SOUTH IN BISHOPSGATE. CROSSED THE TRAFFIC LIGHTS ON GREEN AT THE JUNCTION WITH THREADNEED	1 Gracechur	0.5	0.8	14760	5904
533220	181140	VEHICLE 1 TRAVELLING EAST IN LEADENHALL STREET. VEHICLE 3 WAITING TO TURN RIGHT INTO ST MARYS AXE. AS VEHICLE 1 TR	1 North are	0.75	0.8	14760	8856

<u>Glossary</u>

ACCSTATS	Accident Statistics database (online reporting)
ANPR	Automatic Number Plate Recognition
CHI	Crime Harm Index
CJU	Criminal Justice Unit
CoLCHI	City of London Collision Harm Index
CoLP	City of London Police
CRS	Collision Reporting System
DDACTS	Data Driven Approaches to Crime, Congestion and Traffic Safety
DfT	Department for Transport
ESRI	Environmental Systems Research Institute (Mapping Software)
GIS	Geographic Information System
GPS	Global Positioning System
HGV	Heavy Goods Vehicle
KSI	Killed or Seriously Injured
LIP	Local Implementation Plan
PACTS	Parliamentary Advisory Council for Transport Safety
RPU	Roads Policing Unit
SCRAS	Standing Committee on Road Accident Statistics
STATS19	National Collision Database
STOT	Safer Transport Operations Team
TFL	Transport for London
UK	United Kingdom
US	United States
VPF	Value in Preventing a Fatality
VRU	Vulnerable Road User
WTF	Willingness to Pay