

**How do Emergency Vehicle Markings and Warning  
Systems influence the interaction between Emergency and  
Civilian Drivers?**

by  
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Doctoral Thesis

Submitted in partial fulfillment of the requirements for the award  
of Doctor of Philosophy of Loughborough University

July 2020

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## Abstract

### Aim

The primary aim of the research presented in this thesis was to establish if emergency vehicle markings and warning systems influenced the way in which either a civilian or emergency driver responded when interacting during emergency driving situations. This was achieved by utilising a variety of research methods and a wide range of data types, including self-report questionnaires, Police collision reports, and real-world video data. The intention was that the findings could be used to inform approaches towards improving the on-road interaction between civilian and emergency drivers.

### Background

Numerous emergency vehicle interactions occur without incident, yet some result in near misses, and collisions – both minor and serious in nature. Previous research (Shultz et al. 2009) has reported that civilian drivers often act in an adverse manner such as a panicked reaction (Gormley et al. 2009), due to poor vehicle salience, or modern vehicle soundproofing and technology distractions, when interacting with a responding emergency vehicle. Consequences of these negative interactions include feelings of frustration by the emergency driver, blame apportionment, and financial and reputational damage to the organisations themselves. Following an extensive review of the literature, research therefore firstly established the opinions of emergency and civilian drivers. Subsequent analysis of data, involving use of both marked and unmarked Police vehicles then helped to establish whether near misses and collisions occur as a result of marking type, through poor conspicuity (salience and warning systems) or as a result of behavioural change in the drivers themselves.

### Methods

The research was conducted through four studies, using a multi-methods approach, to establish i.) The attitudes and opinions of emergency service drivers towards the public through questionnaire survey. ii.) A comparison between both marked and unmarked Police vehicle collision data and the effect of emergency warning systems on collision liability, over a 4.5 year time frame utilising telematics data from both vehicle marking types. iii.) Analysis of Police real world video footage observing the interaction between a civilian driver and a responding Police vehicle. iv.) Civilian

drivers' perceptions of how they interact with the emergency vehicle when allowing for its presence on the road through questionnaire survey.

## **Results**

Important findings identified through self report questionnaires showed that Police drivers believed they were the least aggressive drivers, in comparison to their emergency service driver peers. Ambulance drivers were the most frustrated with other road users but were more willing to discuss their feelings, whilst Fire Service drivers were more likely to take risks in order to arrive more quickly at an emergency situation. Evidence gathered and reviewed showed that the public reacted in two distinct ways when giving ease of passage to an emergency vehicle. On high speed roads, civilian drivers showed an initial delayed reaction, but having observed the approaching vehicle, moved away in a calm manner. For interactions within an urban environment the civilian driver was more likely to commit a driving violation such as mounting a pavement or travelling through a red light. However, this was mainly due to the Police drivers making rapid progress when near to other vehicles, forcing the civilian driver into their subsequent actions. Analysis of telematics data showed that Police drivers in marked vehicles were more likely to be involved in 'blameworthy' collisions when the emergency warning systems were operational compared to when they were switched off. For 'blue light' use, this increased Police collision liability by 69%, for 'flashing headlights' use by 78%, and for 'sirens' use by 120%. However, importantly this behavioural effect was not seen in an unmarked Police vehicle as collision liability was found to be due to operational tasks such as stopping offenders. As a result, this study suggests that poor conspicuity was not a factor in collisions/events but was an outcome of Police driver behaviour and driving style.

## **Conclusion**

The results are highly informative in providing an understanding of collisions between marked and unmarked Police and civilian vehicles as driver behaviour influenced the collision liability. It is anticipated that the results from this thesis could be used to influence emergency driver training through increased focus on emotion management in driving, and active occupational policies which engage with drivers. Training should focus on the increased risks of driving a highly conspicuous emergency vehicle, compared to its unmarked counterpart, and the influence warning systems have on

collision outcomes. This would lead to an increase in the safety of all parties. In addition, it could potentially lead to reduced organisational costs whilst aiding the development of public education campaigns including advice on appropriate civilian driver response to approaching emergency vehicles through use of government literature and social media.

## Acknowledgements

**Academic.** Thanks go to Professor Andrew Morris and Ruth Welsh for allowing me the freedom to pursue my PhD with their unending patience.

**Professional.** This PhD was made possible by being given access to personnel from the emergency services who kindly assisted in the research. My thanks are given to the Fire and Ambulance services who supported the distribution of questionnaires for the initial study. They have also shown interest in the results which is a positive move in changing future training and the assistance and advice given by North West Ambulance Service, West Midlands Fire Service and Oxfordshire Fire and Rescue Service.

To complete this PhD, the availability of highly sensitive data was required so a huge debt of gratitude must be given to South Wales Police who provided access to information, personnel and databases not normally afforded to a civilian. Without the assistance and guidance of Gareth Morgan and PC Martin “Buzz” Lightfield, the research would simply not have been possible.

To Gareth whose knowledge, support and friendship over the years was unquestioning and for allowing me to repeatedly use him as a sounding board when it was all going desperately wrong. Thank you for making me believe in myself again for which I will be eternally grateful.

**Personal.** And most importantly to my family. To Caitlan, Beth, Matt and Tom who have put up with my years of studying, learned to be independent and have never complained. This is to show that anything is possible if you put your mind to it and to always follow your dreams.

Finally, to my parents to whom I owe everything. I hope I have made you proud.

*“All that is needed for motor-car riding is a hand for steering and a head to restrain one’s natural inclination for racing on the public road”*

Automotor Journal, November 1896

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## Abbreviations

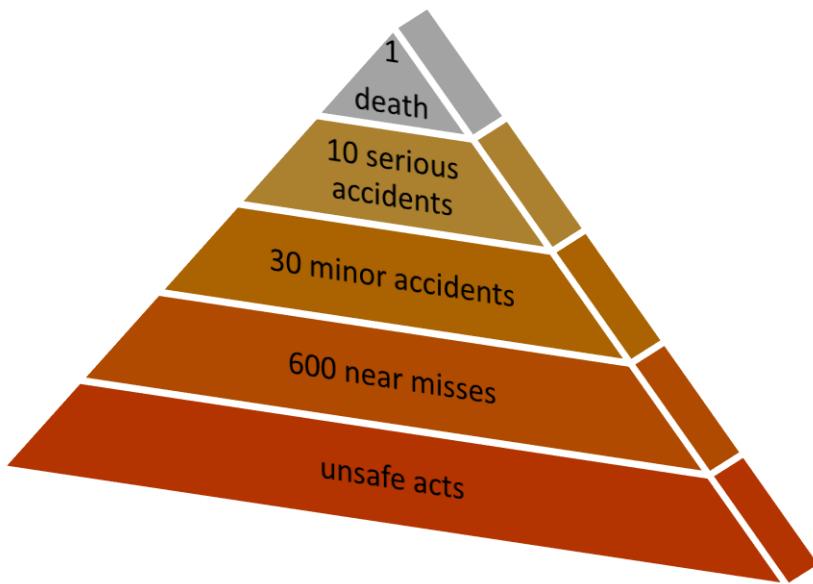
<b>Abbreviation</b>	<b>Description</b>
ACPO	Association of Chief Police Officers
CPS	Crown Prosecution Service
DBI	Driver Behaviour Inventory
DCQ	Driver Coping Questionnaire
DSI	Driver Stress Inventory
DVLA	Driver and Vehicle Licensing Authority
EV	Emergency Vehicle
EWS	Emergency warning systems
FOI	Freedom of Information
HGV	Heavy Goods Vehicle
HSDT	High Speed Driver Training
HSE	Health and Safety Executive
IM	Impression Management
IOPC	Independent Office for Police Conduct
IPCC	Independent Police Complaints Commission
IVDR	In-vehicle data recorders
LGV	Large Goods Vehicle (same as HGV)
MOP	Member of public
MPH	Miles per hour
NHS	National Health Service
NHTSA	National Highway Traffic Safety Administration
NSL	National Speed Limit
NWAS	North West Ambulance Service
OFRS	Oxfordshire Fire and Rescue Service
OSSV	Outstanding Stolen Vehicle
POLAC	Police Accident
PV	Police Vehicle
RTC	Road Traffic collision
SDR	Socially Desirable Responding
SWP	South Wales Police
TPAC	Tactical Pursuit and Containment
WMFS	West Midlands Fire Service
WWFS	West Wales Fire Service

## Chapter 1: Introduction

### 1.1 Research overview

On occasion drivers may be required to interact with an emergency vehicle responding to a 999 call. This interaction may occur without incident, result in a near miss, or end with the possibility of a collision between the parties, resulting in damage only or minor and major injuries. The Independent Office for Police Conduct – IOPC in the UK recently published its annual figures for deaths resulting from a road traffic collision ([www.policeconduct.gov.uk](http://www.policeconduct.gov.uk)) whereby a Police vehicle was in some way involved, either directly or indirectly, such as through an emergency response or pursuit situation. The IOPC stated that in 2018 / 19 there were 42 fatalities from 33 incidents, the highest it has been for 10 years. In the UK in 2018 there were 1,770 road deaths across vehicle types with incidents involving Police vehicles accounting for 2.4% of these. These Police vehicle involved fatalities are thankfully considerably rare events, when compared to the number of Police vehicle emergency calls responded to every year across the 43 Police Forces in England and Wales. One such force, North Yorkshire reported receiving 6,307 emergency 999 calls in May 2018 alone ([northyorkshire.police.uk](http://northyorkshire.police.uk)). It is not possible to gain data that shows fatalities involving either Ambulances or Fire Appliances as this information is not nationally recorded in the public domain (Sanddal, Sanddal, Ward and Stanley, 2010) and is considered later in this chapter. To add some context there were 23,000 emergency calls per day requiring a response from the Ambulance Service in England in January 2018 (NHS England). In 2014 /15 calls to the Fire Service in Wales totalled 27,132 but almost 15,500 did not require action or were false alarms ([www.bbc.co.uk](http://www.bbc.co.uk)). It would not be appropriate to compare these figures as the Services perform very different roles, with varying environment types and population size.

In 1931 Herbert Heinrich considered behaviour based safety and developed what has become known as the Heinrich Triangle. It was later adapted by Bird and Germain (1966) to include near misses and unsafe acts shown in Figure 1.1 and is still in use today within Health and Safety.



**Figure 1.1 : Heinrich Triangle (Heinrich, 1931, later adapted by Bird and Germain, 1966)**

The study by the researchers concluded that for every 1 fatality there would be 600 near miss events and an unknown quantity of unsafe acts. These would not result in a collision, but some action would have been required by one of the parties. It is these latter types of events that are largely unquantified within emergency driving and there is little evidence to suggest how the near misses or unsafe acts themselves may manifest within the context of driving under those circumstances.

This thesis has considered interactions that have resulted in a collision between a Police vehicle and a third party, along with observational data that may give an insight into the types of near misses or unsafe acts that may occur.

Research suggests that there is a potential problem with civilian drivers when they are confronted with an emergency vehicle responding to an emergency (Shultz, Hudak and Alpert, 2009; Clarke, Ward, Bartle and Truman, 2009). Yasmin, Anowar, and Tay (2012, p90) described an emergency vehicle (EV) as “*any vehicle that is subjected and authorised to respond to an emergency to ensure the delivery of vital services during a crisis and is deployed for rescuing people in an emergency*”. Collisions involving these vehicles can have not only negative effects on those immediately involved, but additional financial and reputational consequences (Dorn and Brown, 2003) for the Service or Force. There is a danger that the public view of the events can be altered through the media and create an impression that a collision is more common than the actual reality (Symmons, Haworth and Mulvihill, 2005).

Studies have suggested that Police drivers consider the “public” unpredictable (Dorn et al. 2003; Shultz et al. 2009). Furthermore, 95% of Fire Service drivers, questioned in Ireland, believed the “public panicked” on seeing an approaching emergency vehicle (Gormley, Walsh and Fuller, 2008). Such findings concur with those of Clarke et al. (2009) who postulated that collisions with an emergency vehicle were due to civilian drivers’ failure to observe signals. Saunders and Heye (1994) noted that civilian drivers do not give way and are prone to inattention, leading to crashes with emergency vehicles, whilst the US Fire Administration (USFA 2002, p5) described the reasons for Fire Truck crashes as due to the “*reckless driving by the public*”.

The question of how a civilian driver is perceived to have reacted may lead to negative feelings from the emergency drivers such as annoyance or frustration of a slow moving vehicle (Trick et al. 2012). The extent of those feelings may be led by personality traits and a study by Mitchell and Bray (1990) suggested that individuals with certain personality characteristics self-selected which emergency service they may work for, although Wagner, Martin and McFee (2009) suggested there was little published research which tested this theory. Salter- Pedneault, Ruef and Orr (2010) examined the identified gap of whether the Police and Fire personnel did display differing personality characteristics and as such differed when reacting to stressors. The researchers found that emergency personnel scored more highly for extraversion in their personality when compared to the general population, and that they differed in the way they reacted to mild stressors. This was however early on in their working careers within two varying training environments. It is accepted that the effects of short term emotion changes can lead to a lowering of cognitive function (Malta, Miyajima, Kitaoka and Takeda, 2011), causing momentary lapses in attention or near misses (Neale, Dingus, Klauer, Sudweeks and Goodman, 2005).

The literature suggested that civilian drivers may be to blame for crashes that occurred with emergency vehicles. However, it is equally possible that the emergency driver may be at fault due to the unique driving tasks they can undertake whilst on response and the varying characteristics of the vehicles used (Hsiao, Chang and Simeonov, 2018). Hsieh, Colas and Kanwisher (2011) believed crashes between emergency response and civilian vehicles was due to poor vehicle conspicuity against a cluttered backdrop whilst De Grave, Deroo, Calle, Vanhaute and Buylaert (2003) suggested

that emergency drivers can be aggressive on the road which, coupled with driving at excessively high speeds (Melby, 2001; USFA, 2014), also led to collisions.

Marquis (1992) estimated that non-fatal occupational injuries cost the US economy \$83 billion with motor vehicle costs (Miller and Galbraith, 1995) accounting for 6% of the total (\$4.98 billion). However, it is difficult to accurately establish the true picture of the costs, number, or type of collisions that occur which involve an emergency vehicle. Tiesman, Heick, Konda and Hendricks (2015) considered work related vehicle crashes, as the leading cause of on duty deaths for US Law Enforcement Officers. The researchers found that one fatality could cost employers approximately \$500,000 in direct and liability costs whilst a non-fatal crash could cost \$74,000. Lambert (2016) reported that in Orlando, USA between 2016 and 2010 there were an average of 7,400 law enforcement crashes costing \$25 million in property damage alone each year.

Whilst the financial costs may be immense there are unacceptable human costs, with the US Fire Administration (2014a) reporting that between 1996 and 2012 there were 137 civilian fatalities, and 228 civilian injuries from Fire Service vehicles. In addition, there were 64 civilian fatalities and 217 civilian injuries relating to Ambulance incidents. By comparison, the UK (IOPC, 2018) reported that there were 29 civilian and Police Officer deaths as a direct result of a responding Police vehicle in 2017/18.

In the UK, under the Police Reform Act (2002) the Police are required to record serious road accident injuries and fatalities at a national level in cases, where a Police vehicle has collided with a vehicle owned by a civilian, with the information recorded being available publicly from the Independent Office for Police Conduct (IOPC). However, there is no such requirement for the Fire and Ambulance Services to do the same and each of these latter Services record collisions at an individual Ambulance Trust or Fire and Rescue Service level as mentioned earlier. The lack of a national Ambulance database for crashes was reported by Sanddal et al. (2010) when investigating US collisions which, as the researcher noted, limits understanding of contributing factors. UK Police emergency response drivers receive extensive initial and periodic training, as directed by the College of Policing Approved Professional Practice (College of

Policing<sup>1</sup>), in how to safely negotiate traffic in higher than average speeds, once an emergency call has been received. To assist in the safe passage of these vehicles civilian drivers should aid them by moving out of their way, and there is no reason to suggest they would not want to assist (Drive, 2008). For a responding emergency vehicle to alert other road users of its presence it may utilise its emergency warning systems (Turner, Wylde, Langham and Morrow, 2014; Missikpode, Peek-Asa, Young and Hamann, 2018). However, Shultz et al. (2009, p3) noted that emergency drivers should also operate caution when on response as the warning systems “*do not create an invisible shield*” around them. This is supported by a study conducted by the US Fire Administration (2014a) which found that emergency drivers developed a false sense of invulnerability with lights and sirens operating and as such took more risks.

For civilian drivers their ability to perceive an emergency vehicle may vary considerably based on their usual driving locations, such as rural or urban environments (Burke et al. 2001). Sanddal et al. (2010) suggested civilian drivers were ill informed in how to respond to the lights and sirens, with education deemed to be essential. Saunders and Gough (2003) reviewed the interactions civilian drivers may have encountered with an Ambulance in the county of Staffordshire in the UK. The respondents gave responses relating to the previous three months from when the research took place. Whilst most interactions occurred on an A-road (32.4%), this was not the highest proportion per 1000 miles travelled. In fact, the most interactions per 1000 miles travelled were on a Dual Carriageway, and the least interactions per 1000 miles travelled were on C roads and unclassified roads. The full results of the interactions can be seen in Table 1.1.

The USFA (2014a) remarked that ideally all civilian vehicles would move over and stop if approached from the rear by a responding vehicle. They noted that the reasons for a failure to react may be due to a lack of driver attention, lack of awareness due to noise protection inside the vehicle compartment, loud music and distractions such as phones.

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<sup>1</sup> College of Policing *Police Driver Training* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/#Police-driving-training>

Road classification	Interaction (n)	Interaction (%)	Road length (miles)	Interactions / 1000 miles
Motorway	2	1.9	72	28
Dual Carriageway	14	13.3	145	311
A road	34	32.4	754	45
B road	19	18.1	337	27
C road	17	16.2	1357	13
Unclassified	8	7.6	3301	2
Pedestrian crossing, paths, pavements	11	10.5		
Total	105	100		

Table 1.1: Civilian vehicle interactions with Ambulances by road type in Staffordshire

Design (Saunders and Gough, 2003)

The UK Highway Code, rule 219, contains guidance for drivers in how to react to an approaching emergency vehicle and states “**Emergency and Incident Support vehicles. You should look and listen for Ambulances, Fire Engines, Police, Doctors or other Emergency vehicles using flashing blue, red or green lights and sirens or flashing headlights, or Highways Agency Traffic Officer and Incident Support vehicles using flashing amber lights. When one approaches do not panic. Consider the route of such a vehicle and take appropriate action to let it pass, while complying with all traffic signs. If necessary, pull to the side of the road and stop, but try to avoid stopping before the brow of a hill, a bend or narrow section of road. Do not endanger yourself, other road users or pedestrians and avoid mounting the kerb. Do not brake harshly on approach to a junction or roundabout, as a following vehicle may not have the same view as you”.**

Newer designs of vehicles are further protected from the outside world (through engineering and structural improvements) thereby reducing the level of sound penetrating the vehicle (Caelli and Porter, 1980; De Lorenzo and Eilers 1991). This, coupled with music systems and numerous in-vehicle distractions (e.g. Driver information systems) further detaches the driver from the outside world and adjacent traffic. The result can potentially mean collisions with an emergency vehicle, late reactions causing a short delay for the emergency vehicle or civilian driver collisions with other road users once the “blue light” vehicle has passed through known as the “wake effect” (Clawson, Martin, Cady and Maio, 1997). The wake effect was described

as appearing to be caused by the passage of the emergency vehicle passing through but did not actually involve the emergency vehicle in any collision (Clawson et al. 1997).

Several studies have considered the common causation factors relating to emergency vehicle collisions (Custalow and Gravitz, 2004; Drucker, Gerberich, Manser, Alexander, Church, Ryan and Becic, 2013; LaTourette, 2015). Such factors included the weather, road type, and time of day. Additional studies have also investigated why a civilian driver may be involved in a collision with an emergency vehicle with Missikpode et al. (2018, p262) citing possible reasons being the emergency vehicle's higher speed and the civilian drivers "*inability to respond*". Clarke et al. (2009) acknowledged that, in a civilian vehicle collision, the emergency vehicle was at least partly to blame. Whilst being highly trained may give the emergency drivers an increased sense of ability (USFA, 2002), there is ultimately no guarantee that these skills will be used whilst on response (Dorn et al. 2003). Additionally, Dorn et al. (2003) found that Police drivers may take more risks due to a higher sense of invulnerability whilst Custalow et al. (2004) suggested a combination of factors may lead to higher accident rates such as complex interactions between the road environment, the emergency driver and civilian driver.

The process of driving an emergency vehicle, which then interacts with another road user whilst responding, may invoke negative driving reactions by both a civilian driver and an emergency driver. The word "panic" has sometimes been used by researchers to describe a civilian driver reaction (Caelli et al. 1980; Saunders et al. 2003; Gormley et al. 2008; Drive, 2008) when interacting with a responding emergency vehicle. The concept of panic is also acknowledged in published driver guidance such as the UK Highway Code as previously identified. The notion of driver "panic" is considered further in Chapter 2. For a highly trained driver, including those from the emergency services on response (Dorn et al. 2005; Symmons et al. 2005), the task of moving around a civilian driver may be frustrating. It is accepted that driver stress (both short and long term) and its subjective states may have a detrimental effect on driving performance (Fuller, 2000) and the extent to which this occurs will depend on the individual's coping methods, whether directed from their personality type (Mitchell et

al. 1990; Salters-Pedneault, Ruef and Orr, 2010) or level of driver experience (Hsiao et al. 2018).

The following chapters aim to add to the literature in how an emergency and civilian driver may interact on the road and if negative behaviours exist, when linked to the markings or emergency warning systems.

## **1.2 Research Objectives**

The primary objective of this thesis was to establish if markings and warning systems on an emergency vehicle influenced the way either a civilian or emergency driver responded when interacting during an emergency situation.

A large body of research has previously considered collisions involving emergency vehicles, and to a lesser extent the behaviour of a civilian driver around an emergency vehicle (Clarke et al. 2009; Drucker et al. 2013). This latter point focused on a driver who may be the subject of the Police vehicles attention or who was engaged in criminal activity. There appears to be only a small amount of research which considered a civilian driver's action when required to ease the passage of the emergency vehicle by moving position (Gormley et al. 2008). However, this was limited to self-report questionnaires from the Fire Service and several researchers noting seemingly anecdotal adverse reactions by civilians within published papers (Caelli et al. 1980; Dorn et al. 2003; Saunders et al. 2003; Shultz et al. 2009), but little further evidence as to why this was believed to be the case.

This thesis used a qualitative approach to consider the comparative views from the Police, Fire and Ambulance services to establish if they shared similar values regarding civilian drivers. A review of the literature suggested that a comparison of self-reported views from each of the three main emergency services had not previously been undertaken. Further review also identified that collisions involving both marked and unmarked Police vehicles was limited with previous focus on a marked, liveried vehicle. By comparing the two livery types it would provide a unique comparison of how each marking type interacts with other road users and whether this

influences the reaction, in conjunction with the use of emergency warning systems not previously seen in publications.

It is acknowledged in the literature that collisions between the emergency services and civilian drivers are problematic (Hsieh et al. 2011; Tiesman et al. 2015) and the thesis used quantitative methods to establish if the use of the warning systems on specific emergency vehicles affected the collision liability between an emergency and civilian driver. A comparison was also made to establish if conspicuity of the vehicle namely marked (i.e. liveried) or unmarked (i.e. covert) affected the collision liability. The thesis considered whether a Police or civilian driver's actions, which did not result in a collision were appropriate during interaction in dynamic traffic situations through use of an observational approach.

Few published studies could be identified which considered how the Police and civilian drivers interact from a behavioural aspect, during an emergency response. Those identified (Clarke et al. 2009) noted that civilian drivers did not give way but there was also speculation as to the reasons. Research looking at how the civilian was attempting to move out of the way to allow ease of passage has previously concentrated on the civilian driver being the focus of attention. This thesis used a mixed method approach to investigate the nature and extent of civilian and Police vehicle collisions and conducted an observational study of civilians whilst driving and interacting with the Police vehicles on a response call. The Police vehicles in the study were split into marked and unmarked vehicles whereby the unmarked vehicle was used by Roads Policing for covert operational reasons and the marked vehicle used for traditional traffic policing. This was to differentiate this thesis from other published studies where the unmarked vehicle has no livery or emergency warning systems fitted (Plecas, McCormick, Lee, Cohen and Armstrong, 2014).

The overall aim, using a variety of study techniques, was to establish whether emergency drivers' attitudes and opinions towards civilian driving is evidentially supported by examining collision data and real world on-road data.

It is hoped that the findings from this research can be used to i.) develop policy and procedures within the emergency service driving training programmes to develop a

greater awareness amongst the drivers; ii.) expand on existing public information and funded projects to further public education in reacting with a safe and appropriate course of action; iii.) increase awareness of the influence current emergency warning systems can have on drivers. This could then be used to aid in developing new vehicle technologies such as in-vehicle alerts of impending emergency vehicles or those affecting collision avoidance. This may become increasingly relevant as transportation moves to automation with currently patents being developed (Delp, 2016).

### 1.3 Research questions

**RQ1:** Do Police, Fire and Ambulance service emergency drivers report similar levels of frustration, and have the same perceptions of civilian driving, whilst they are on an emergency response?

- Pilot Study (Chapter 3)
- Self-report Questionnaires (Study 1 - Chapter 4)

**RQ2:** Do the Police, Fire and Ambulance drivers have the same belief that drivers should discuss feelings after an emotional call?

- Self-report Questionnaires (Study 1 - Chapter 4)

**RQ3:** Do the Police, Fire and Ambulance Service emergency drivers each rate their own driving skills as more highly skilled than that of their colleagues in the corresponding emergency service?

- Self-report Questionnaires (Study 1 - Chapter 4)

**RQ4:** Is liability of collision dependent on whether the Police emergency response vehicle is marked or unmarked?

- Analysis of collision data (Study 2 - Chapter 5)

**RQ5:** Is the frequency of collisions between marked and unmarked Police emergency response vehicles and civilian vehicles dependent on time of day?

- Analysis of collision data (Study 2 - Chapter 5)

**RQ6:** Does the operation of the Police vehicle emergency warning systems affect the collision liability?

- Analysis of collision and Telematics data (Study 2 - Chapter 5)

**RQ7:** Do civilian drivers react in an adverse driving manner when moving out of the way of a Police vehicle which is on response?

- Review of real world video data from Roads Policing vehicles (Study 3 - Chapter 6)

**RQ8:** Do civilian drivers believe their driving action is appropriate and timely when they are required to move out of the way of a responding emergency vehicle?

- Self-report questionnaires (Study 4 - Chapter 7)

- Discussion and conclusions (Chapter's 8 and 9)

#### 1.4 Ethics

Ethics approval was requested and granted by Loughborough University (LU) to cover all aspects of this study and its methodological aspects. Ethics approval for the whole thesis was achieved through completion of the LU Ethical Clearance checklist and completion ensured that a full application was not required due the nature of the research that was conducted. All study participants were provided with an information sheet with details of the purpose of the study. Their consent was obtained before taking part in the study. The information sheet, and questionnaire for Ethics approval can be found in Appendix 1.

Part of the study involved access and the viewing of video footage not gathered directly by the researcher, but from a Roads Policing vehicle, where dashcam and Automatic Number Plate Recognition (ANPR) technology was fitted as standard Policing equipment. It was forward facing, and as such the Police driver could not be identified as it captured data of other vehicles and merely the context in which they were being driven. As a result, further ethics approval was not required as permission had been given by the Force from where the data originated.

## **1.5 Thesis Framework**

The PhD was initially designed around a pilot study supported by four further studies so that an overall picture could be developed examining the interaction between a responding emergency vehicle and a non - emergency driver who subsequently may need to move to allow the emergency vehicle to pass.

### *Literature Review*

Chapter 2 reviewed the current published literature and considered the issues surrounding four key attributes which all interact within road safety and can be dependent on each other. The attributes considered were emergency vehicles (conspicuity, emergency warning systems, and collisions), emergency and civilian drivers (stress, panic and distractions), vehicles / roads (design and monotony) and finally visual processing (scanning and reaction times affecting the task). The factors were identified by Custalow et al. (2004) and Hsiao et al. (2018) as factors involved in an emergency vehicle collision.

### *Pilot Study and initial analysis*

Chapter 3 describes a pilot study which tested the design of a questionnaire aimed at emergency service drivers. This initial study used a small group of Police drivers to test whether the format of an initial and follow-up questionnaire was feasible, and to determine whether the questions would answer the research questions in the best way.

*Do Emergency drivers feel frustration towards civilian drivers whilst responding, due to their own higher driving skills? A quantitative study*

Chapter 4 followed on from the pilot study through study 1, using self-report questionnaires. It was issued to emergency service drivers who were currently employed by the Police, Fire and Ambulance services in the UK. The emergency drivers were asked to consider how they felt when interacting on the roads with civilian drivers whilst responding to an emergency, the emotions they may feel (e.g. whether civilian drivers were a source of stress or frustration) and the coping methods they utilised to manage those feelings.

*Analysis of collisions between Police and civilian drivers*

Whilst study 1 gathered opinions and perceptions from emergency drivers, study 2 analysed the collision data from a UK Police Force to establish if the Police drivers view of liability was accurate when considering the actions of both the civilian driver and the emergency vehicle driver. The collision data was differentiated into two groups involving marked and unmarked Police vehicles and the data was subsequently reviewed to establish the proportion of liability between the emergency driver and a third party. Study 2 also looked at whether the emergency warning systems played a part in collision liability and considered factors such as the time of day a collision occurred.

*An observational approach to the interaction between Police and civilian vehicles*

There are numerous dynamic traffic interactions between emergency and civilian vehicles on the road every day and not all result in a collision. Study 3 utilised real world video data captured from several Police vehicles, (marked and unmarked), whilst on emergency response to establish in greater detail how a civilian driver may react when moving out of the emergency vehicle path. This was intended to provide a deeper insight of near misses and any potential adverse driving reactions portrayed by both parties on the road which could not be established from the collision data alone.

*Self-report views of the civilian driver behaviour around a responding Emergency vehicle*

Study 3 utilised video data from a camera fitted to a Police vehicle and whilst the vehicle movements may be captured it was not possible to extend that to the driver behaviour behind the wheel. This applies to both physical and cognitive distractions. As such a questionnaire was created (study 4) which investigated the self-reported civilian driver behaviours to try to ascertain the reasons behind any actions, reactions or delays when moving out of the responding vehicles way if required. Whilst study 1 focussed on the views of the emergency service drivers, to provide a comparison and alternative view study 4 investigated civilian drivers' actions and reactions when moving out of the emergency vehicles way.

Chapters 8 and 9 bring together the results from studies 1 to 4 with the discussion and conclusion where the research questions were considered, alongside an overall summary with recommendations for future work.

## Chapter 2: Literature review

### 2.1 Plan of the Literature Review

A systematic literature review was conducted to establish current understanding of the topics within published research and to identify where there may be gaps in knowledge which helped define the structure of this PhD.

Key words were used to initially search for the relevant literature using Academic libraries such as that held at Loughborough University alongside online resources including Google Scholar, ProQuest, Science Direct, Taylor and Francis, Sage Journals, Springer Link, Emerald Insight, PubMed, TRID and Wiley Online.

Key words identified: Ambulance, Better than Average, Blue Lights, Civilian, Collisions, Conspicuity, Coping, Covert, Distractions, Emergency vehicles, Field of View, Fire, Frustration, HGV, LGV, Lights, Marked, Mental workload, Monotony, Non-emergency, Panic, Police, Professional drivers, Reaction times, Sirens, Stress, Unmarked, Vans, Visibility, Visual processing, Visual scanning.

The Literature has been grouped into the following subject areas which are then reviewed within this chapter as shown in Figure 2.1.

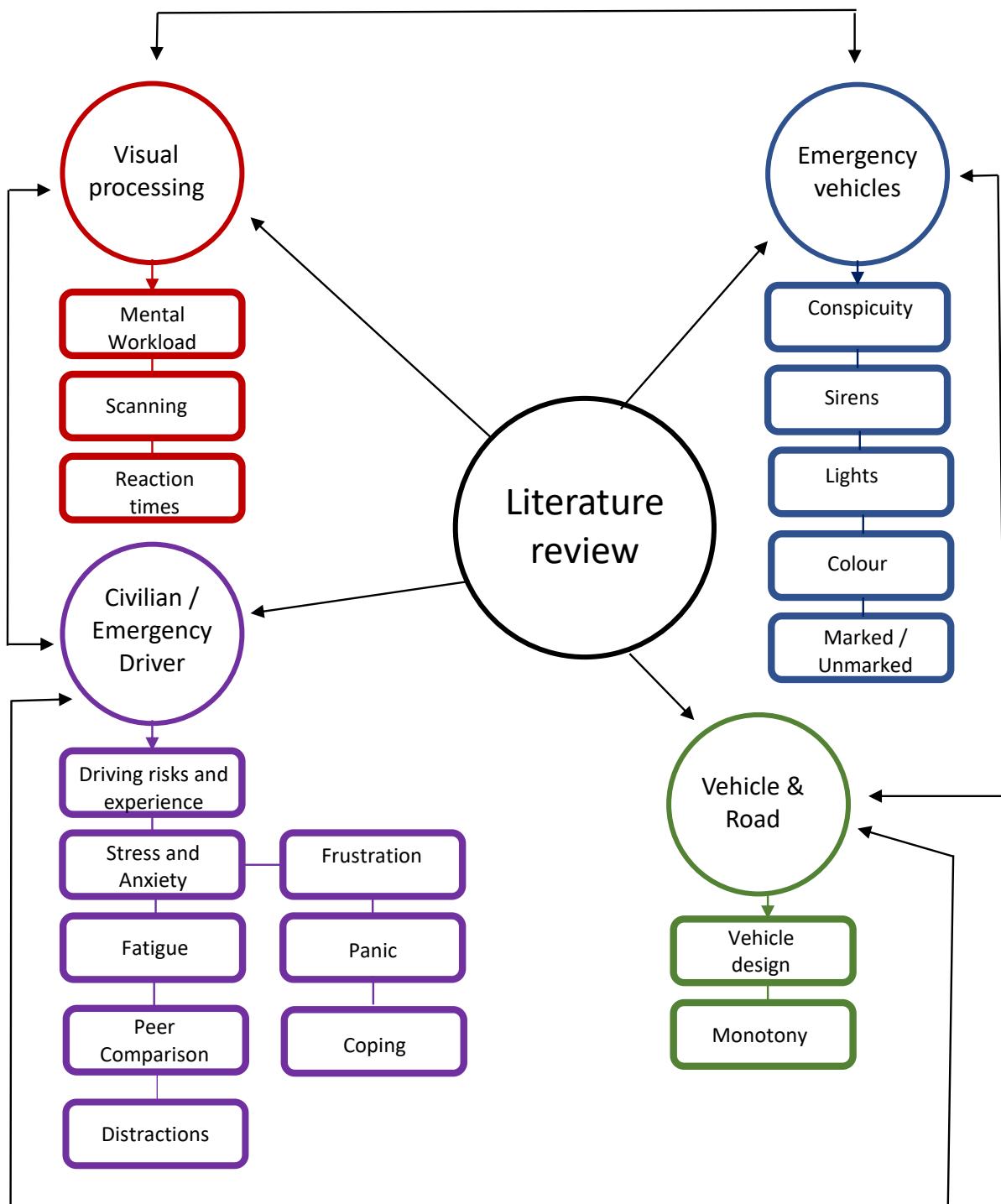


Figure 2.1: Literature review summary

## 2.2 Driving for work

The task of driving is one of the riskiest daily activities undertaken (Svenson, 1981) and comprises a complex set of factors from the environment, the vehicle and the driver (Custalow et al. 2004; Drucker et al. 2013). Drivers with more than a few months experience are known to adapt to those risks as driving becomes an automated process (Summala, 1988). The risks can vary according to journey purpose as those who drive recreationally are often able to choose the pace of the journey, time of travel, vehicle type and speed (Oz and Lajunen, 2007), which can differ from those driving for work. The Office for National Statistics - ONS (2013) reported that 15.3 million people drove for work in the UK equating to 57.5% of the working population. For those that drive for work (commuting) or professionally (as part of their role such as LGV's, vans, buses and taxis), organisational influences add a further consideration. These drivers must also factor in "extra motives" of thinking about work, tiredness, use of the phone and rushing (Salminen and Lähdeniemi, 2002) alongside time scheduling, long or varied hours and higher task demands of the job role (Oz et al. 2007; Clarke et al. 2009). More than a quarter of all road crashes in the UK involve someone driving for work ([www.hse.gov.uk](http://www.hse.gov.uk)<sup>2</sup>) with motor vehicle crashes being the leading cause of work related deaths in the US (Caird and Kline, 2004).

## 2.3 Driving an emergency vehicle

Whilst driving for work, as discussed, carries identified risks the driving of any type of emergency vehicle has even greater risks for both the emergency driver and the general public (Turner et al. 2014). Despite often high levels of training (Dorn et al. 2005), the task of emergency response can be both physically and mentally demanding on the driver (Symmons et al. 2005). This increased demand on emergency drivers may be derived from the higher speeds, the operation of vehicle communication equipment such as radios, "blue lights" or sirens (Manser and Even, 2002), the induced stress from the nature of the call itself, or the external road and the environment (Custalow et al. 2004; Clarke et al. 2005). Symmons et al. (2005) observed that the driving of an Ambulance was likely to be more stressful than the

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<sup>2</sup> HSE Driving at work. Managing work related road safety [Online] <http://www.hse.gov.uk/pubs/indg382.pdf>

driving of other emergency vehicles due to them having multiple occupants such as patients causing added distractions. The role of these types of vehicles can undoubtedly increase the cognitive load of the driver (Manser et al. 2002) and it is only in more recent years where the task of driving, within the job role, has received attention due to changes primarily within Health and Safety legislation in the UK (Coeugnet, Naveteur, Antoine and Anceaux, 2013). The Independent Police Complaints Commission (IPCC) investigated deaths following pursuits in the UK and could not find a correlation between the number of people seriously injured or killed and the use of emergency warning systems (IPCC, 2007 p22).

Many drivers underestimate their chances of being involved in a collision (Dorn et al. 2003). However, for emergency drivers these chances are arguably higher than other drivers due to the higher speeds often used. A US study by Maguire, Hunting, Smith and Levick (2002) looked at the occupational fatality rates amongst Emergency Medical Services (EMS) vehicles finding a rate of 9.6 fatalities per 100,000 EMS workers, attributed principally to a top heavy vehicle design. This compared to 6.1 fatalities per 100,000 EMS for the Police and 5.7 fatalities per 100,000 EMS workers for Firefighters. The national average was found to be just 2.0 per 100,000 workers for transportation incidents. Mares, Coyne and Macdonald (2013, p17) additionally reported that drivers were three times more likely to be involved in a collision when responding to an emergency but did not expand on why this may be the case.

Emergency vehicle collisions, regardless of fault, can be costly - not only financially, with vehicles forced out of service (Yasmin et al. 2012), but undermined public confidence in the Police (Clawson et al. 1997; Crundall, Chapman, Phelps and Underwood, 2003) and damaged reputations (Dorn et al. 2003). For those events considered high profile thorough media attention the public's view can reportedly be distorted into thinking that a collision is more common than it really is (Symmons et al. 2005). The immeasurable cost, both financially and emotionally, from fatal collisions that occur on the roads are perhaps just the tip of the iceberg. Delays, damage to vehicles and property, injuries, lost fleet time, replacement vehicles and even legal proceedings (Yasmin et al. 2012) can add huge financial burdens to an organisation who are already finding budgets difficult to balance in the current economic climate.

Stress felt by the emergency driver can be immense with Courts now prosecuting not only the emergency service but the individual driver who is also being held accountable (Burke, Salas and Kincaid, 2001). Surveys carried out by the UK Police Federation have found that Police drivers fear being prosecuted following a 999 call or high speed pursuit (Police Federation, 2016), with the Crown Prosecution Service (CPS) stating that each case must be considered on its own merits.

Collisions involving emergency vehicles were estimated at 12,000 per annum in the US in the mid 1990's (Clawson et al. 1997) which was almost certainly a conservative estimate but can be assumed to have cost millions of dollars. The National Highway Traffic Safety Administration, NHTSA, (Custalow et al. 2004) reported that between 1991 and 2000, in the US, there were 301,404 non-fatal emergency vehicle (Police, Fire and Ambulance) collisions which subsequently rose to 368,946 between 2001 and 2010, a rise of 22%. Caution is required given that data interpretation can suffer from under reporting or incorrect recording (Jeffrey, Stone, Blamey, Clark, Cooper, Dickson, Mackenzie and Major, 2009).

In the UK, Sir Alastair Graham previously reported (within the Annual Report of the Police Complaints Authority) on fatalities within the Police service (Best, 2003, p3). He stated that "*there has been a 178% increase in fatalities involving pursuits over four years which is totally unacceptable*". Subsequent national policy changes led to an overall decrease in fatalities amongst UK Police Forces, as a result of a Road Traffic Collision until 2014 but the numbers have since begun to rise (as shown in Table 2.1). There has been a 241% increase in deaths between 2013/14 and 2017/18 but the report does not go into detail as to why that might be the case (IOPC, 2018). The statistics relate to either civilians or Police Officers directly involved in the incident.

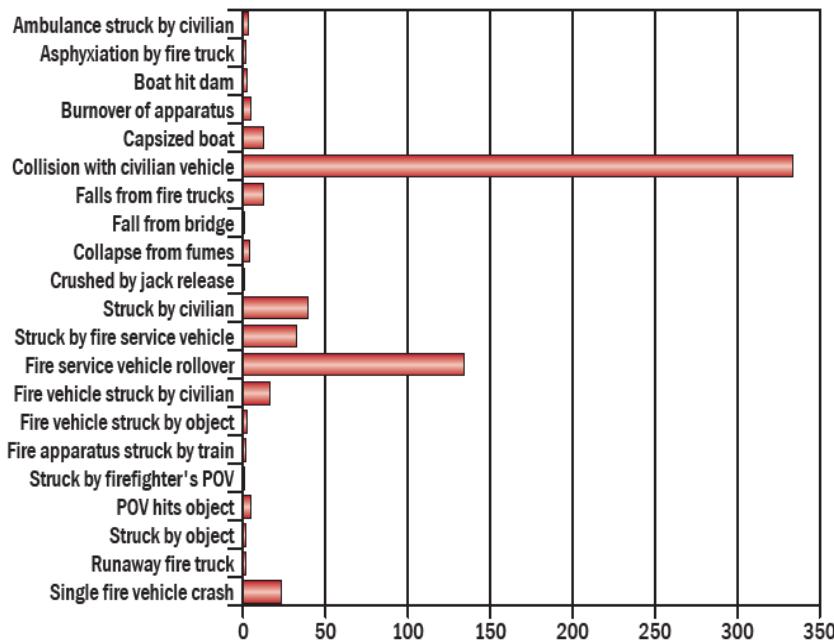
2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15	2015/16	2016/17	2017/18
24	40	29	26	19	31	12	14	21	32	29

**Table 2.1: Fatalities following an RTC involving a Police vehicle 2007 – 2018  
England and Wales (IOPC)**

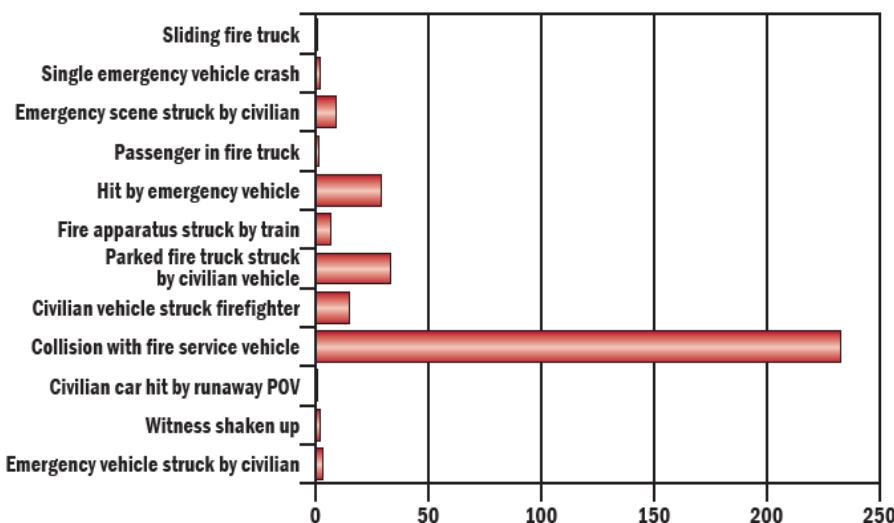
Under the Police Reform Act (2002) the Police must report all fatalities or incidents involving civilians and Police vehicles through the IPCC (now known as the

Independent Office for Police Conduct - IOPC) with some high level Police collision data available as a matter of public record.

A review by the US Fire Administration (2014a) reported that the principle reason for an emergency vehicle collision with a civilian vehicle is either of the driver's failure to give way at a junction. The administration department found that civilian vehicle collisions were the highest cause of injury collisions regardless of liability as can be seen in Figure's 2.2 and 2.3.



**Figure 2.2: Civilian injuries due to Fire service vehicle incidents 1996 - 2012**  
(US Fire Administration, 2014a)



**Figure 2.3: Firefighter injuries in non-fatal vehicle incidents 1996 - 2012 (US Fire Administration, 2014a)**

It is not possible to fully establish the risks nor make comparisons to the UK Ambulance and Fire Service personnel or civilian interactions whilst driving due to the lack of central collision data recording. Both the Ambulance and Fire service do not record information nationally (Sanddal et al. 2010) with no requirement to publicly publish such data. A further problem encountered by Researchers was difficulty in accessing any data from the Ambulance Service due to Data Protection issues and reported by James and Wright (1991) and Glendon and Coles (2001). However, Priestman (2005) noted that according to the Department of Transport there was on average one collision a day involving an Ambulance during 2003. From a research perspective Dorn et al. (2003) also reported that Police collision data could be difficult to access and as such made studies harder to complete.

Dependent of the level of training (Department for Transport, 2013) certain professional groups of drivers are authorised to operate emergency warning systems (flashing blue lights, sirens or flashing headlights) in the UK. UK legislation affords emergency driving certain Road Traffic Law exemptions as detailed within the College of Policing guidance (College of Policing<sup>3</sup>). For the Fire Service this is further clarified within the High Speed Driver Training Code of Practice (HSDT, 2008) and for the Ambulance Service by the Driver Training Advisory Group (DTAG, 2014). The Road Traffic Regulation Act (1984) and The Traffic Signs Regulations and General Directions (2016) state emergency drivers can exceed speed limits, (dependant on their level of training), travel on the wrong side of a keep left bollard, can go against the direction of a road sign such as “no U-turn”, and can treat red traffic lights as “Give way” situations. Legal exemptions are awarded with regards to traffic law and a summary issued to Police emergency drivers can be found in Appendix 2 illustrating the exemptions according to the different authorised levels of driver training, being “basic”, “response” and “advanced”. These exemptions were noted by Dorn et al. (2003) and latterly Missikpode et al. (2018) remarking that this type of driving along with dealing with in-vehicle technologies may increase collision risk. However, these exemptions can only be claimed if the action is justifiable and proportionate, the vehicle is being used for the intended purpose and only if it is safe to do so. This was

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<sup>3</sup> College of Policing *The Law in respect of Response driving* [Online]

<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/#complying-with-traffic-lights>

confirmed in the case of *R v Bannister* (LCCSA, 2009), a Roads Policing Officer who, whilst responding to a call, drove at 113mph on an unlit motorway in heavy rain. He subsequently crashed, and the car was damaged beyond repair. Bannister was charged and convicted of dangerous driving despite arguing that 2 years prior he had completed an Advanced Police Driving course which meant he was better qualified to deal with those conditions than an ordinary motorist.

Emergency calls are graded by a call operator and this grade determines the response given as defined by the Association of Chief Police Officers (ACPO, 2005 p26). Police Grade 1 (G1) calls are considered an emergency and are passed on to a driver immediately. It could be as a result of danger to life, serious injury, crime in progress, injury type road traffic collision, or to detain a known offender. Grade 2 (G2) calls are responded to as an emergency but within an hour to include events such as burglary, sudden death, domestic abuse if the offender has left, or to gather time sensitive evidence. Calls graded 3 and 4 (G3 and G4) are non-emergency in nature (ACPO, 2005; Sussex Police). As previously discussed, the role of an emergency driver is highly regulated in legislation as is the training programme itself. Rehn, Davies, Smith and Lockey (2016) looked at the risks surrounding rapid response vehicles within a UK Ambulance Trust highlighting some of the considerations a driver may have to make whilst responding (Figure 2.4).

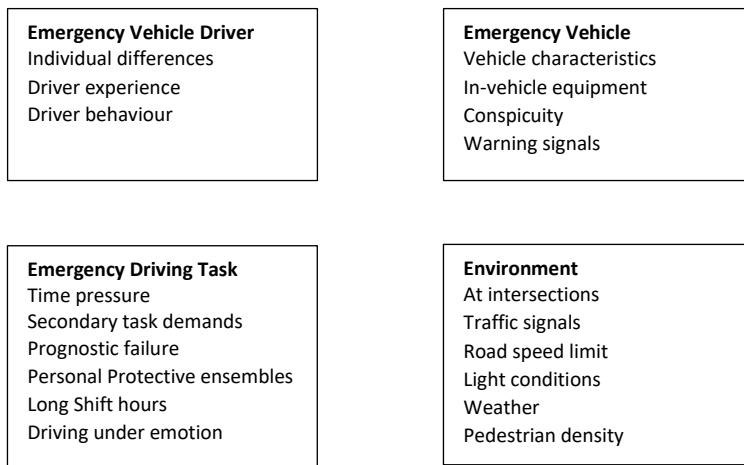


**Figure 2.4:**  
**Emergency Driving**  
**considerations in an**  
**Urban setting (Rehn,**  
**Davies, Smith,**  
**Lockey, 2016)**

The report highlighted that the two most common collision types between civilian and emergency drivers were “looked but failed to see” and “inattention”. Even with the large volume of research surrounding the use of emergency vehicles consideration should be given by the driver to whether the risks of high speed driving are justified (Rehn et al. 2016). Ho and Casey (1998) conducted trials on routes using both emergency and non-emergency responses finding a mean time saving of just 3.02 minutes. A separate study by Hunt, Brown, Cabinum, Whitley, Prased, Owens, and Mayo (1994) found similar benefits of 43.5 seconds using “blue lights” and sirens. They noted that whilst it was a substantial difference it was not clinically significant unless associated with life support such as the use of a defibrillator. Missikpode, Peek-Asa, Young and Hamann (2018) suggested that although the use of emergency warning systems were designed to alert road users, the emergency vehicles speed choice and the inability of the civilian drivers to respond in time could be a contributory factor in increasing crash risk. The increased speed of a vehicle, including that of an emergency type was also observed as being linked to collisions by Saunders et al. (2003).

Missikpode et al. (2018) concluded that the operation of the warning systems was associated with increased risk factors for crashes. Clarke et al. (2009) had earlier observed that collisions with an emergency vehicle were due to the civilian drivers’ failure to observe signals but Drucker et al. (2013) reported that this was too simplistic. Drucker et al. (2013) examined the factors suggested by Custalow et al. (2004) in more detail to establish why a civilian driver may not identify an emergency vehicle until too late. The study concluded that civilian vehicle crashes with an emergency vehicle were due to a variety of factors dependant on the driving conditions such as road lighting, obstructions (which included buildings and road signs), cognitive and in-vehicle distractions resulting in a lack of concentration.

A meta-analysis by Hsiao et al. (2018) found that emergency vehicle collisions could be categorised into four sections as shown in Figure 2.5. The researchers considered in detail each of the factors observing that emergency vehicle drivers can be influenced by personal factors which affect their performance whilst driving such as age, gender, training and negative behaviours. These were identified as risky attitudes, and overconfidence.



**Figure 2.5: Categorisation of emergency vehicle collisions (Hsiao et al. 2018)**

The task of emergency driving was related to both occupational and vehicle demands such as the operation of the emergency warning systems. Hsiao et al. (2018) also evaluated the impact of vehicle size and how it affected the visual capabilities of other road users due to obstruction, alongside the effect of lights, sirens and colour in order to make passage through traffic. The final environmental factor took account of multi-lane junctions which increased conflict risk, light conditions which affected vehicle conspicuity and inclement weather. Custalow et al. (2004) acknowledged that collisions could be a combination of factors involving the emergency driver, civilian and environment but the use of emergency warning systems was not a predictor of collisions specifically resulting in injury for the medical service.

When considering collision liability or “culpability” of an individual the investigator at the scene considers all contributory factors (Brubacher, Chan and Asbridge, 2014) such as location, vehicle / driving conditions, task difficulty and the contribution of other parties. Dorn and af Wåhlberg (2019) noted that several descriptions were used in studies including at fault, blameworthy, responsible and culpable, alongside two simple categorizations as being the driver caused the collision and the driver actions did not contribute, but all aiming to mean the same. Research by Feigenson, Park and Salovey (1997) found that those who were responsible for apportioning blame following collisions were often biased if the severity was greater, and that it should be about attribution of liability rather than injuries which determined culpability. af Wåhlberg (2009) reviewed several previously published research papers and found that culpability judgements were often made by Insurance companies, company

supervisors, traffic administrators, collision investigators, and transport companies but observed that it could also be the Police who decide (as they are the investigators and complete the relevant paperwork). Custalow et al. (2004) commented on a possible sympathy or bias shown by the Police towards Ambulances involved in a collision and Biggers, Zachariah and Pepe (1996) found 67% of collisions were the fault of the civilian but they accounted for 89% of all traffic enforcement notices issued. The researchers suggested that this may be due to Law Enforcement Officers being reluctant to issue notices to fellow emergency workers.

If Police were the investigators, Brar (2014) considered it unlikely that an Officer would knowingly assign fault to an innocent party due to an awareness it may be challenged within the judicial system. Alternatively, Dorn et al. (2019) suggested that the Police may be biased in their judgement of culpability for all types of crashes regardless of the number of vehicles involved. Historically general Police investigation policy into a collision involving one of its own vehicles has involved visiting the scene, recording of witness statements and a thorough forensic review of the site and vehicles involved. Dorn et al. (2003) studied the responses from Police Officers and found that Officers recounted their own collision incidents as if they were the expert witnesses and that the cause of those collisions was due to the unpredictability of other road users or unfavourable conditions. Clarke et al. (2009) commented that when an emergency vehicle was involved in a crash the emergency vehicle itself was more likely to be the passive party due to the civilian driver seemingly making a mistake. In a meta-analysis by af Wählberg (2009, p110) the Police gave themselves the lowest rating of culpability not least as drivers, regardless of the profession of the involved parties, and appeared keen to apportion blame elsewhere through self-reporting. In the Dorn et al. (2003) study the Officers reported themselves as being a low risk to the organisation and recalled the collisions in such a way as to reduce their own accountability which caused the Police drivers to believe themselves half as likely to be involved in a blameworthy collision, compared to that of a non-blameworthy collision.

For non – emergency drivers Chapman and Underwood (2000) found that in general, such drivers would limit their recall of an event, and thus culpability, if they felt they were not to blame. This corresponds to research that individual drivers believe their own driving to be better than that of other drivers (Svenson, 1981). af Wählberg (2009,

p101) suggested that culpability could be difficult to establish with no accepted definition of responsibility in research and therefore researchers simply accept the assignment of culpability by another party. This difficulty has been subsequently addressed by Dorn et al. (2019) suggesting more specific coding structures from a bus company's original assignment of culpability in the collision data. It was proposed that where behavioural culpability was being considered, as opposed to legal culpability assignment for insurance or prosecution purposes, then exposure data should be applied such as mileage or hours driven.

Advances in technology over the last few years have added extra and invaluable methods of providing evidence in collisions, namely the use of in-vehicle data recorders (IVDR) and video equipment. Within the context of emergency driving the use of video recording equipment can become even more significant and beneficial, providing important evidence which protects both the emergency and civilian drivers alike. Evidence is independent and non-contradictory, whilst also potentially acting as a moderating force thereby preventing the emergency driver taking unnecessary risks or actions (IPCC 2007, p22).

These technological advancements have become a more recent addition to methods of driving research with the use of a naturalistic data study approach (Welsh, Reed, Talbot, Morris, 2010) with data historically collected through a variety of methods including questionnaires and the use of simulators. Questionnaires are an effective way to question larger numbers of participants to gather views on a variety of subject areas but can be prone to self-report bias (Lajunen, Corry, Summala and Hartley, 1997; Lajunen and Summala, 2003) and recollection issues (Maycock, Lockwood and Lester, 1991; Chapman et al. 2000). Simulators have the advantage that they can train situations otherwise considered too dangerous on road and in a wide variety of vehicle types (Goode, Salmon and Lenné, 2013) making them cost effective as a training alternative. Goode et al. (2013) noted that trainees can learn new skills and transfer them to real driving but there was no evidence that this method of learning affected crash risk. One disadvantage to using a simulator is that participants may suffer the effects of simulator sickness making training and assessment ineffective (Neukum, Lang and Krueger, 2003). The researchers also noted that this can be particularly problematic for high speed driving programs which require a high level of

visual skills and in some cases actual motion depending on the fidelity of the simulator. This can vary from low fidelity such as a single screen computer through to those with a motion base and 360° field of view (Goode et al. 2013). A further disadvantage with simulators is that they have been criticised for the lack of risk within programmes and are too simplistic compared to a real vehicle (Dingus, Klauer, Neale, Petersen, Lee, Sudweeks, Perez, Hankey, Ramsey, Gupta, Bucher, Doerzaph, Jermeland and Knipling, 2006). Langham et al. (2002) stated that however effective a simulator was it could not fully replicate real world driving with participants aware that it is an experiment and as such mistakes not considered as important. This was evidenced by Taib, Tederry and Itzstein (2014) who examined driver frustration with the use of a small tri-screen simulator. The participants were observed growing frustrated with different situations but realising it was a simulator laughed the frustration off.

A further study method is that of naturalistic data collection which involves IVDR, and in some cases mounted video cameras. It allows individuals to be observed unobtrusively over specific time frames (Welsh et al. 2010) and to capture real world data where individuals may be engaging in various driver behaviours which are hard to measure using more traditional methods (Guo and Fang, 2013). It also provides an accurate insight into how people drive, allowing driver behaviour to be analysed in relation to any specific or critical events that may occur, giving this research method high validity.

## 2.4 Civilian driver experience

It is possible that drivers may be unsure how to move out of the way of an emergency vehicle despite a desire to aid its passage through (Caelli et al. 1980), and therefore experience confusion and panic (Drive, 2008). Burke et al. (2001) suggested that for many drivers the interaction with an emergency vehicle was a rare event so can be unaware of the best course of action. In cognitive psychology theory (Bartlett, 1932) the building up of knowledge from an early age creates what is known as schema. Bartlett (1932, p201) referred to these schema as "*an active organisation of past reactions, of past experiences, which must also be supposed to be operating in a response*". This is how the brain codes new information and stores it so that it creates memory and it is such schemas that help us interpret a situation to then be able to

decide on an appropriate action (Ghosh and Gilboa, 2014). Learning to drive exposes us to new situations, where we build up schemas, and develop situational awareness skills which in turn aid with future exposure to hazards (Groeger and Banks, 2007). Research by Salmon, Lenné, Young and Walker (2013) considered driver incidents at a rail crossing and found that those drivers who had an inadequate or poorly developed schema, failed to notice the warning signs, and the likelihood of not noticing the presence of a train on a crossing increased accordingly.

In 2002, the UK Government introduced hazard perception testing designed to improve situation awareness in novice drivers (Crundall, Chapman, Trawley, Collins, Loon, Andrews and Underwood, 2012). The authors commented that it was hoped that novice drivers and instructors would be encouraged to use such testing as a focus on differing hazards during training. Garay, Fisher and Hancock (2004) found that, on testing, and due to their own experience as a pedestrian the novice drivers were much better at detecting pedestrian hazards. In research by Jackson, Chapman and Crundall (2009) the authors discussed the learning to drive process with Driving Instructors. The Instructors reported that skills for hazard perception were not taught until near the end of the licence acquisition course as the demands on the learner driver would be too great whilst still mastering the physical skills of vehicle handling and road traffic management. For novice drivers Salmon et al. (2013) reported that the schema was more orientated to vehicle control rather than situational awareness. Furthermore Underwood, Ngai and Underwood (2013) observed that novice and therefore inexperienced drivers scanned the road less than their experienced counterparts and reacted more slowly to hazards (McKenna and Crick, 1991).

In the UK licence acquisition training merely requires competence to deal with other road users safely and not specifically interaction with an emergency vehicle. A copy of the UK licence acquisition form (DL25) can be found in Appendix 3, and the interaction with another road user would be assessed under Box 26 for "Awareness/Planning", if the opportunity for being in that situation arose during the test itself. This could have implications for some drivers as, according to test conditions, or where they live may have rarely encountered an emergency vehicle whilst driving (Burke et al. 2001; Saunders et al. 2003) and as such have poorly developed schemas, should an event arise. It has been reported that civilian driver

experience in knowing how to effectively or safely negotiate an emergency vehicle encounter can vary widely. However, for any driver the ability to identify the emergency vehicle must first be evaluated which is considered in the next section.

## **2.5 Emergency vehicle conspicuity**

Responding emergency vehicles employ several methods to get themselves noticed through a combination of sirens, flashing lights, colours and markings. These vehicles have been specifically designed to help achieve rapid movement through traffic and fast arrival at the required destination. However, such transit carries a huge risk to safety for anyone in or near the vehicles path and therefore a time saving of perhaps just a few seconds should be weighed against the associated risks as discussed in the previous paragraphs.

A large body of research has occurred over the years investigating the best methods surrounding emergency warning systems, markings and colour on an emergency vehicle to improve conspicuity (Solomon and Hill, 2002) which is reviewed below.

### *2.5.i Sirens*

The presence of sirens on emergency vehicles have been in existence for decades, although the omitted sound has however changed, as new technologies and understanding of their usage is developed (Flanagan and Blower, 2005). Countries who use emergency vehicles have warning systems fitted to warn others that they are approaching, and to ease their passage (De Lorenzo et al. 1991; Lenné, Triggs, Mulvihill, Regan and Corben, 2008) through to a critical event.

There are generally considered to be three types of sirens being “yelp”, “wail” and “hi-lo” (Catchpole and McKeown, 2007) although the UK also now uses a 4th known as the “Bullhorn” (Rehn et al. 2016). The names describe the different pitch and tone emitted from the vehicle siren and can range from between 1 and 4 tones within each type. The sirens are activated and used, according to Service or Force Operational guidelines, by the driver as they deem necessary with the changing situation and in any combination, they choose (South Wales Police). However there seems to be little

agreement as to which siren type is the most effective (De Lorenzo et al. 1991). Different emergency services, in both the UK and abroad, use varying sound frequencies and there does not appear to be common ground even though the “yelp” and “wail” tones are considered as standard (Balastegui, Romeu, Clot and Martin, 2013). For the civilian driver it is therefore likely to be difficult to identify which type of vehicle is approaching, merely that one is. Effective warning signals should meet four simple criteria (Kuwano, Namba, Shick, Höge, Fastl, Fillipou, and Florentine, 2007) – (i) it must be easily recognisable in busy environments, (ii) perceived by every age group, (iii) recognisable as a warning siren and (iv) recognisable by every nationality. Several studies have investigated how difficult it may be for a motorist to identify where the sound is coming from due to the design and noise reduction features of a modern vehicle (Caelli et al. 1980; De Lorenzo et al. 1991). Drivers now must contend with improved insulation qualities, distractions such as phones, passengers, air conditioning, music, and technology. This may lead to insufficient time to detect another vehicle resulting in a collision and this should be borne in mind in respect to Caelli et al. (1980) who observed that drivers did not react until an Ambulance was 100 metres from them.

The frequency variation has been developed to reduce annoyance to those who live near emergency centres (De Lorenzo et al. 1991; Balastegui et al. 2013) but must also be heard above the noise of city centre living or from inside the vehicle. However, a siren which registers at above 120dB may have an adverse effect on those at close proximity (Caelli et al. 1980) and Balastegui et al. (2013) found (in their study of the effectiveness of the differing siren tones) that for a driver to be able to detect it under any circumstance it would need to be at an extremely high decibel level. For the sirens to be heard, and then an effective and timely course of action taken by the civilian driver, the siren itself must emit sound into the vehicle at a level greater than that emitted by the vehicle itself (Solomon et al. 2002). Therefore, it must be loud enough to be heard over any internal vehicle noise (such as road noise or music) or external environmental noises, in good time. Research from Solomon et al. (2002) considered initially the sound intensity with the engine off (Table 2.2) and then with in-vehicle distractions to establish how far away the EV may be before being detected.

Distance of siren to Car	Sound Intensity (dB)	Siren to Car angle
50 feet	82.2	0 degrees
100 feet	79.2	0 degrees
200 feet	63.2	0 degrees
300 feet	53.7	0 degrees

**Table 2.2: Sound intensity of wailing siren as measured inside a vehicle with the windows closed and the engine off (Solomon and Hill, 2002)**

Solomon et al. (2002) reported that some sirens could reach sound levels of 115 decibels, measured when 50 feet directly in front of the siren. However, if measured from inside a stationary vehicle with the windows closed the noise level could drop to 82 decibels illustrated in Table 2.2.

Using the comparison of a car travelling at 35mph, with no air conditioning or radio operating, Solomon et al. (2002) found inside the vehicle, the siren had an internal decibel reading of 56dB. Balastegui et al. (2013) reported that the noise intensity inside a Ford CMax (medium sized people carrying vehicle) with a high radio level can reach 83dB at 80km/h (50mph). This means that a siren would not be heard even at close proximity to the civilian vehicle, so awareness and reaction is now reliant solely on the vision of the driver. Caelli et al. (1980) went as far as to say that due to road users overestimating the distance of an Ambulance by a factor of 2, sirens should be used as a last resort and for only a brief period.

A US department report referenced in De Lorenzo et al. (1991) stated that, with the normal masking noises from the environment and modern vehicle insulation, a siren only had maximum penetration into the vehicle of between 8m and 12 m at a junction. A vehicle travelling at just over 50kph (30 mph) would cover this distance in just under 1 second (Table 2.3) which is clearly insufficient for a driver to take any form of avoiding action.

Green (2000) calculated a reaction time to be 1.5 seconds (Green, 2000), at 30mph, and a driver would have travelled 66 feet (44 feet x 1.5 seconds) before even applying the brakes (Table 2.3). There is no agreement however on standard reaction times

and this is considered later in this review. Lenné et al. (2008) also reported that sirens are not able to be projected over a long distance, as well as having to overcome environmental noise so it can be difficult to estimate the distance of the approaching EV.

Distance vehicle travelled		
Miles per hour	Feet per second	Metre per second
20	29.3	8.93
25	36.7	11.19
<b>30</b>	<b>44.0</b>	<b>13.41</b>
35	51.3	15.63
40	58.7	17.89
45	66.0	20.12
50	73.3	15.24
55	80.7	16.76
60	88.0	18.29
65	95.3	19.81
70	102.6	21.34

**Table 2.3: Relationship between miles per hour and distance travelled (Green, 2000)**

It is acknowledged that the references identified are several years ago and vehicle comfort has improved, resulting in better soundproofing for drivers and passengers. Modern vehicles could make identifying the proximity of sirens more difficult for a driver than that discussed, with sound providing just one method of identifying an emergency vehicle with flashing lights and visual clues such as colour also available to a driver.

### 2.5.ii Lights

Legislation surrounding the manufacturer of flashing lights and even the luminance of colour are highly controlled falling under UNECE Regulation 65 ([www.unece.org](http://www.unece.org)). The use of emergency lights and sirens is widespread, and many emergency services have now issued protocols for the drivers as to when they should be used (NAEMSP, 1994; Hunt et al. 1994). The tone of the sirens and the optimum rate of the flashing headlights (Turner et al. 2014) may vary between countries, but they are all designed with the

same purpose in mind - to reach someone, or something, quickly (De Lorenzo et al. 1991). Sivak (1996) claimed that 90% of the information used when driving was visual and forms an important part of the interaction between different road users alongside auditory cues. Visibility itself takes account of the vehicle size, reflective qualities, conspicuity and the colour contrast against a background (De Lorenzo et al. 1991).

Research around emergency vehicle design has shown that flashing lights are more likely to attract attention than if it had been steady (Solomon et al. 2002), providing that the intensity of the flashing light was less (Gerathewohl, 1953). It must stand out from what may already be a busy environment in today's modern world (Berkhout, Dell, Schieber, 1999). However once identified the driver then must decode it and act appropriately as a driver which is not always the case (Solomon et al. 2002, p48). A report by the National Bureau of Standards, in Solomon et al. (2002, p44) stated that "*particularly because people become flustered in emergencies, it is important to keep the number of different warning light configurations that must be remembered to a minimum. Severely limiting the number of possible signals will tend to reduce the time required for a target driver to recognise any one of the signals and to recall the appropriate reaction*". Missikpode et al. (2018) considered crash risk when the emergency systems were operational and found that the risk increased for Police vehicles but not for Fire and Ambulance vehicles. A drawback of the study was that the researchers considered marked Police vehicles rather than unmarked vehicles, thereby not providing a true comparison of the risks.

There is a commonly held belief that time is saved by using emergency warning systems (Hunt et al. 1994; Ho et al. 1998; Merlin, Baldino, Lehrfeld, Linger, Lustinger, Cascio, Ohman – Strickland and DosSantos. 2012) but this must be weighed against the inherent risks with Mares et al. (2013, p17) reporting that vehicles are three times more likely to be involved in a collision when responding to an emergency. Hunt et al. (1994) found a mean time saving of less than a minute and that the use of emergency warning systems by Ambulances was not warranted apart from extreme circumstances where there is a medical need such as in Cardiac Arrest (NAEMSP, 1994; Hunt et al. 1994; Grundgeiger, Scharf, Grundgeiger, Scheuchenpflug, 2014). Sanddal et al. (2010) noted that Ambulance drivers may assume that road law exemptions allow them to disregard the traffic controls completely, such as stop signs

and red traffic signals, thereby placing both themselves and civilian road users at risk. No similar studies are available which identified a Police or Fire response. However, Missikpode et al. (2018) found in their review that the increase in Police collisions was due to speeding or driving at speeds which were too fast for the conditions with a Police vehicle able to manoeuvre more easily than its larger counterparts – namely an Ambulance or Fire Appliance.

Grundgeiger et al. (2014) considered whether the physical operation of switching on and off the emergency lights and/or sirens within an Ambulance was a distraction itself. The study found that whilst manual distractions when driving did not differ in duration between the state of “blue lights” and sirens being on or off, what altered was the proportion of time spent on each distraction. When the emergency warning systems were activated, they accounted for 50% of the total distraction time due to the operation of using them. Furthermore Klauer, Dingus, Neale, Sudweeks and Ramsey (2006) reported that if a driver took their eyes away from the road for more than two seconds the chances of a near miss or collision were double that of the normal baseline. Grundgeiger et al. (2014) suggested the emergency warning system operation should be from the steering wheel hence limiting the amount of time drivers took their vision from the road. Missikpode et al. (2018) also found that distractions for a Police driver may increase crash risk due to a higher number of tasks including navigation, communication, activation of the emergency systems and the role of response driver itself with the technology distraction accounting for 12% of the crashes recorded.

It has been discussed that the lights fitted to an emergency vehicle are designed to attract attention but can cause a distraction for the emergency driver in terms of their operation. However, for a civilian driver to be able to react they must first visually establish the presence of the lights or vehicle itself and then distinguish them in what may already be a cluttered background.

### *2.5.iii Visual perception*

Whilst the human eye uses central vision for clarity, peripheral vision detects the object (Solomon et al. 2002, p17). The brain is directed to focus on the object and humans

notice what they are interested in as it is different, stands out or contrasts well to the environment (Solomon et al. 2002, p17). As reported flashing lights can attract attention but when an individual then turns towards the light source it is at that point that the colour becomes evident (Howett, Kelly and Pierce, 1978). The light colour used for the emergency lighting deliberately sends a message to the civilian driver, in that it is a genuine emergency or alternatively that it would be courtesy to move course as the vehicle is on its way to assist in an emergency. For example, in the UK, a green beacon indicates a ‘Doctor on Call’, but they have no legal exemptions with regards to road laws.

Due to modern vehicle soundproofing, compared to their older counterparts, emergency lighting takes on a greater significance (Tunniciff, 2005). The human eye is sensitive to certain colours, discussed in the next section of this chapter, with Rumar (1974) commenting that “*blue beacons are almost too good in night-time conditions in the respect that they cause discomfort, but they are poorly visible in bright daylight conditions*”. A combination of different coloured lights is thought to be more effective than a single coloured light (Rubin and Howett, 1981) and the Society of Automotive Engineers (1999) concluded that a combination of red and blue lights should be used in both day and night conditions to obtain maximum performance. “Blue lights” were traditionally used on Police vehicles until more recently but they are now more commonly used in combination with red flashing lights and alternate flashing headlights.

Another factor affecting driver vision and hazard visibility is the lenticular halo (Spencer, Shirley, Zimmerman and Greenberg, 1995) that can be seen emanating from a light source, such as from fog lights. These are the concentric rings that surround the light source itself and create a halo (Streid, 2001). The “bloom” creates a hazard for a driver by obstructing the view of either other road users or hazards in the background (Figure 2.6).

Whilst the effect of this halo may lead to reduced safety benefits Flanagan, Blower and Devonshire (2008) noted that drivers may overestimate the extent to which their vision is impaired and as such drive with greater caution when passing an emergency vehicle at night displaying flashing blue lights.



**Figure 2.6: The ‘Halo’ created by blue emergency lighting**

There appears to be general agreement that the operational use of lights and sirens increases the risk of a collision which results in an injury (Saunders et al. 1994; Custalow et al. 2004; Slattery and Silver, 2009) yet there is also disagreement as to the reasons why this may be so. Slattery et al. (2009) reported a false sense of security by the driver in a high visibility vehicle together with an assumption that other drivers may see or hear them approaching. Saunders et al. (1994) found that for operational emergency warning systems collision rates were higher than for non-lights and sirens use. With Saunders et al. (1994) utilising Ambulances in their study it was not clear if the “non-lights and sirens” drives were for an emergency response, but the driver had chosen not to use the warning systems at that time. Custalow et al. (2004) did not find the warning systems themselves to be a predictor of a crash.

#### *2.5.iv Colour and Markings*

When considering vehicle conspicuity researchers have examined how important colour is in relation to identification of a vehicle type (Solomon and King, 1995). The human eye is more sensitive to some colours than others, peaking in the yellow – green spectrum as shown in Figure 2.7 (Chidlow, 2012), with the eye red weak. Solomon et al. (1995) compared Fire Appliance collisions in the US in one town, where half of the vehicle fleet were red and the other half lime-yellow. The results showed that collisions involving lime-yellow vehicles at junctions were half that of the red vehicles as red can be a difficult colour to detect particularly in dim or low-level lighting conditions.

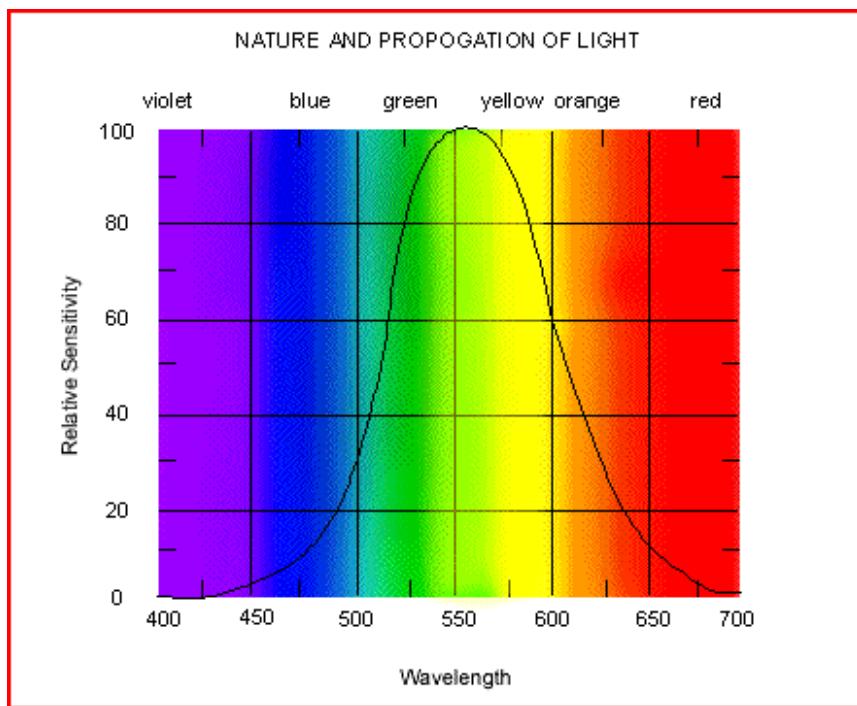


Figure 2.7: Human Eye Sensitivity Chart

Traditionally base colours most associated with emergency vehicles in the UK are red which is applied to Fire appliances, yellow to Ambulances and until relatively recently blue / white to Police vehicles. Whilst red is perhaps not the most appropriate due to it being a weak eye colour, it holds an inference of danger (Solomon et al. 1995; Solomon et al. 2002) which can contribute to civilian driver identification alongside reflective markings and warning lights (Solomon et al. 1995). Chidlow (2012) noted that conspicuity was an important part of the identification process, along with siren noise, with the eyes then actively searching the environment looking for what they expected to see. This recognition search is known as “cognitive conspicuity” (Tijerina, Shulman, Wells and Kochhar, 2003).

The UK Home Office, in the early 1990's, commissioned research (Harrison, 2004) into best practise for vehicle markings on emergency vehicles which led to an extensive change of vehicle markings, remaining in place today. The pattern, known as “Battenburg” through its highly reflective blockwork design, encompasses the distinctive yellow and green colours best identified by the naked eye (Figure 2.8 and 2.9). The colour and markings have not been without criticism with several studies commenting that, in cluttered urban areas the colour may suffer from the effects of

camouflage and decreased conspicuity (De Lorenzo et al. 1991) due to the block design breaking up the shape of the vehicle itself so becoming less recognisable (Tijerina et al. 2003).



**Figure 2.8:**

**Modern UK Fire Appliance and Ambulance with “Battenburg” markings**

**Figure 2.9:**

**UK Home Office Approved Police liveried vehicles showing half “Battenburg” (left) and Full “Battenburg” (right).**



Several researchers have suggested that collisions are influenced by poor conspicuity. Hsieh et al. (2011) noted fewer collisions with an emergency vehicle occurred on dark roads, due to the environmental contrast, when the emergency warning lights were in operation. Conversely the same study also suggested that collisions, caused by a third party, would be greater on a lit road as the vehicle was more difficult to see in an already overcrowded environment. Crundall, Chapman, Phelps and Underwood (2003) noted several publications have reported that pursuit collisions were more likely to occur during darkness but it was not known if this was due to poor conspicuity or an increase in certain criminal activities under the cover of darkness. Both Crundall et al. (2003) and Hsieh et al. (2011) reported on liveried (marked) Police vehicles only considered as a limitation.

A study by Langham, Hole, Edwards and O'Neill (2002) considered why stationary Police vehicles, which were protecting a scene, were struck on high speed roads where there was good daylight and no decrease in conspicuity. Langham et al. (2002, p170) commented that “*drivers who have, in broad daylight and with an unrestricted view of the road ahead, nevertheless failed to detect a parked vehicle covered in reflective stripes and using flashing blue and red lights*”. The researchers were specifically looking at collisions where the Police vehicle was stationary and attributed

the collisions to “looked-but-failed-to-see” or “inattentional blindness” (Mack and Rock, 1998) as it is also known, for cognitive reasons. For clarity looked-but-failed-to-see describes a collision where the driver has looked at the other party yet fails to actually see them until it is too late and was originally described by Treat (1980). Mack et al. (1998) noted that an object may go unnoticed by an individual, not because it has become hidden or obstructed but because attention has been taken elsewhere. Drivers using the same roads frequently have repeated exposure to the same perceived risks and as such attention is diverted elsewhere which is particularly so for Motorway and Dual Carriageway driving (Langham et al. 2002).

All US States, except for Hawaii, adopted a Law called *Move Over, America* ([www.moveoveramerica.com](http://www.moveoveramerica.com)). Developed in 2007 the States have slowly introduced the legislation designed to protect Officers who have stopped another motorist and as such are themselves stationary. The law requires motorists to move away from an emergency vehicle by at least one lane to create a buffer zone, or slow down to a reasonable speed if the lane gap is not possible. Penalties range from \$50 fines through to licence endorsements and even prison. Canada also implemented the legislation in 2012 (Transports Québec), known as *Slow Down, Move Over* which varies between Province requiring a motorist to move to the hard shoulder or stop to allow a responding emergency vehicle, from any direction easy passage through the gap. Carrick and Washburn (2012) evaluated the behaviour of drivers to the Move Over US legislation and found that when the Police vehicle was stationary 75% of drivers moved across with the use of red and blue emergency lighting increasing compliance to 80%. The researchers were unable to verify why this may be the case although speculated about conspicuity.

This section has considered the importance of both emergency warning systems and colour in relation to a driver being able to identify an emergency vehicle more efficiently. Some emergency services have further adopted the use of unmarked / covert type vehicles principally for operational reasons and by their very nature lack the conspicuity of their marked counterparts with their role considered below.

## 2.6 Role of marked vs unmarked Police vehicles

Research around the use of a highly visible and liveried emergency vehicle is extensive (Custalow et al. 2004; Chidlow, 2012; Hsiao et al. 2018) but less focus has been given to that of the unmarked car (Plecas et al. 2014; Powell, 2014). Powell (2014) commented that it has become more common place for emergency vehicle fleets to deploy a variety of vehicles according to the role they may undertake.

Unmarked emergency vehicles can fall under two categories. The first, as shown in Figure 2.10, allows the driver to fit a temporary magnetic beacon to the roof, which is removed when not on an emergency call. Senior officers, Ambulance, and Fire personnel may respond to an emergency using private vehicles such as when on call, but not based at a station, deploying emergency lights and sirens usually a blue beacon temporarily fixed to the roof of the vehicle (Cook, Quigley, and Clift, 1999).



**Figure 2.10:**

**Example of a vehicle fitted with  
a temporary blue light beacon**

The second type is that of a covert type Police vehicle, used for enforcement purposes but who wish to remain discreet with Loftus and Goold (2011, p279) describing covert Policing as “*where officers are concerned to blend into the background and not stand out*”. For these vehicles the lights and sirens are permanently fitted but the base colour of the vehicle remains the same as any non – emergency vehicle. The disadvantage as noted by Solomon et al. (2002) is that, whilst the lights are located low down on the vehicle, they can often be blocked by other traffic making identification more difficult for other road users. For the purposes of this thesis any Police vehicle which is not liveried on the body of the vehicle is referred to as unmarked (but is used for covert type policing and fitted with emergency warning systems) as shown in Figure 2.11, to distinguish it from its marked counterpart.

**Figure 2.11:****Example of a “covert” type Police vehicle**

These covert vehicles are seen to provide a stealth mode which does not allow the driver time to modify any adverse behaviours as they are unable to easily locate the reflective markings or light bars usually associated with law enforcement (Powell, 2014). Powell (2014) also reported that the vehicles are now adding video equipment to provide court evidence should it be required.

Salmi, Voeten and Keskinen (2000) reported that the presence of a Police vehicle aids in deterring crime and overall an increase of Police visibility has been found to improve driver behaviour, such as speed compliance and mobile phone use along with casualty reduction (Walter, Broughton and Knowles. 2011). However, these studies refer to “marked” vehicles only. Marked Police vehicle presence has been found to reduce driving violations and act as a deterrent for other road users (Rothengatter, 1982) whilst surveillance in an unmarked vehicle increases the number of violations detected but does not act as a deterrent (Nilsson and Sjögren, 1981) with an early view by the Organisation for Economic Cooperation and Development (OECD) that unmarked Police cars are generally less effective than marked Police vehicles. This was also established by Soole, Watson and Lennon (2009) who found that covert methods had limited effectiveness.

There is a counter argument that these unmarked Police vehicles are unfair on a motorist and that if they are used regularly for law enforcement then signs should be displayed advising motorists (Powell, 2014).

Research by Plecas et al. (2014) found that within the Royal Canadian Mounted Police (RCMP), vehicle collisions involving an unmarked Police vehicle accounted for 31% of all collisions. This compared to 31% of marked vehicles with emergency equipment activated and 38% for marked vehicles where the equipment was not activated. Such data suggests that the unmarked vehicles were of the first type described above (no markings, no emergency warning systems) rather than covert vehicles due to there being no mention of the emergency warning systems. The same report also found that a marked vehicle with activated emergency equipment was more likely to be speeding at the time of the collision than a marked vehicle with non-activated emergency equipment (21%) and an unmarked vehicle at 16%. Although Plecas et al. (2014) investigated the main causation factors of emergency vehicle collisions they were unable to determine fault as to whether the Police vehicle hit another vehicle or they themselves were hit by a third party due to incomplete data.

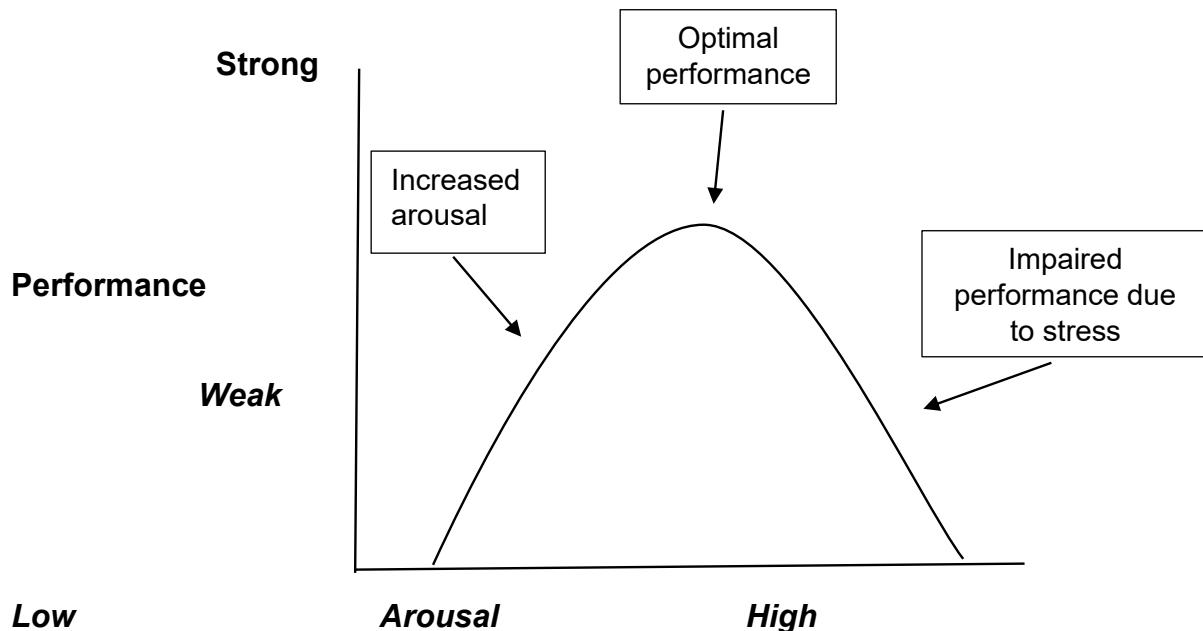
The literature review has identified several research studies which have noted the effectiveness of marked or unmarked vehicles for Police operational reasons, and the benefits or crash risk of emergency warning systems being used relating specifically to a marked vehicle. No studies could be identified which directly compared the use of the emergency warning systems on an unmarked “covert” type car or the ease / difficulty that may exist around its identification, when it is on an emergency call, by a civilian driver. The only study which considered the use of an unmarked car compared to a marked car appears to involve a vehicle which did not have emergency warning systems fitted and as such is indistinguishable from a civilian vehicle regarding visibility (Plecas et al. 2014) highlighting a gap in the literature. The interaction between a civilian and emergency vehicle, with difficulty in prompt identification, and numerous distractions not only creates a road risk but arguably will increase driver stress in how to respond correctly which is considered further below.

## 2.7 Stress

There seems to be little universal agreement amongst researchers on how to define stress with no one single definition. An early definition by Howard and Scott (1965, p153) reported that stress was a “*discomforting response of persons in particular situations*” and continued by suggesting that the response was dependant on factors

such as the individual's ability, skills and limitations. Selye (1976, p137) went on to describe stress as "*the non-specific response of the body to any demand made upon it*". Later Mitchell et al. (1990, p4) described it as "*a response to a perceived threat, challenge or change*" and observed that the common thread with most definitions was the response.

Initial work by Yerkes and Dodson (1908) saw the development of what is now referred to as the Yerkes-Dodson Law. The original model considered the strength of a stimulus and the subsequent habit formation, but the theory was tested on animals (Teigen, 1994).



**Figure 2.12:** Yerkes-Dodson Law (1908) developed by Hebb (1955)

The original model was later developed into the inverted U-shape curve model as seen in Figure 2.12 by Hebb (1955) which considered performance based on a relationship with arousal (Teigen, 1994). The arousal takes the form of a stimuli and the increased performance then aids in stopping the processing of irrelevant stimuli (Eysenck, 1989, p324). The strength of the arousal is dependent on the stimulus such as the individual's circadian rhythm (Fuller, 2005) or from within the environment and a rapid sequence of visual stimuli resulting in the recognition of a second stimuli being impaired (Trick et al. 2012). Dobson (1982) noted that as performance increased it

was improved by some feelings of anxiety but only to the point that an individual recognises their own optimum arousal level, as shown by the optimal point in Figure 2.13. The tolerance of a stress level can therefore vary between individuals (Howard et al. 1965; Dobson, 1982) and after this point anxiety further increases, upon which performance would then decrease and this was confirmed by Eysenck (1989).

The relationship between arousal and performance has also been applied to the area of driver behaviour including that of subjective frustration. If an individual is experiencing a higher level of changed emotion (Howard et al. 1965) drivers may show less steering control, exhibit harsh braking (Hancock, Hancock and Janelle, 2012) and it may affect overall driving performance (Trick et al. 2012; Hsiao et al. 2018) due to the cognitive demands being placed on the driver (Fuller, 2000). Gulian, Matthews, Glendon, Davies and Debney (1989, p598) stated that "*the level of driver stress seems to be determined by factors concerned with appraisal of traffic situations and the ability to deal adequately with them as well as factors extraneous to driving*".

Building on previous work (Lazarus, 1999) Matthews (2002) developed the Transactional Model of Driver Stress and Fatigue as shown in Figure 2.13. It considered the link between an individual's personality or sources of external stress to the outcomes or consequences of those factors, depending on how the person copes and interprets the events.

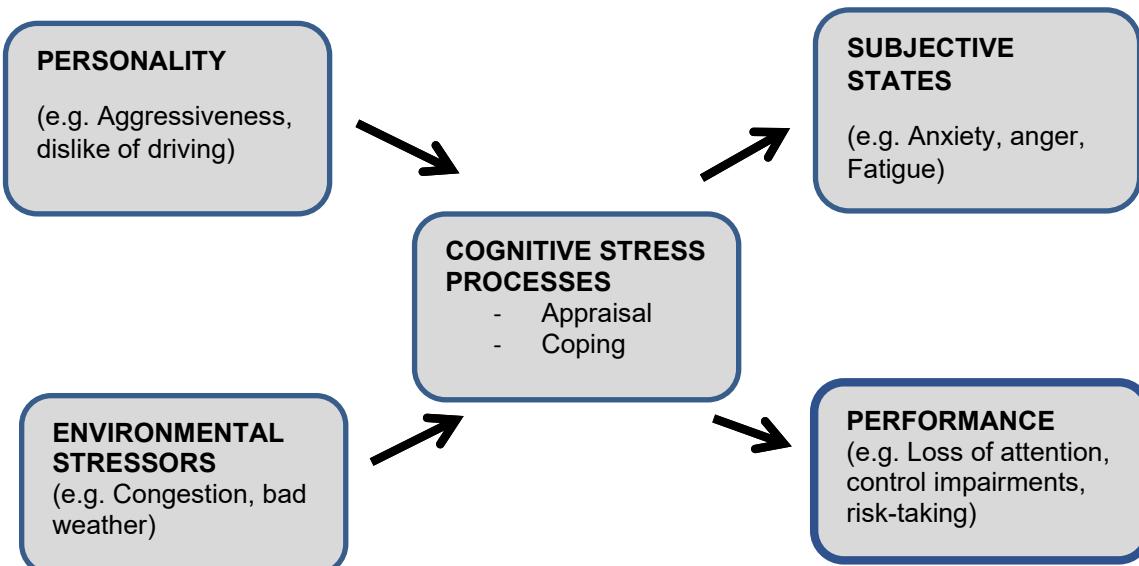


Figure 2.13: Transactional Model of Driver Stress and Fatigue - Matthews (2002)

Personality factors of the model are based on individual differences (Matthews, 2002; Matthews, Emo and Funke, 2005) and Gulian et al. (1989) previously identified five personality factors which affected a person's stress vulnerability. These were dislike of driving, aggression, fatigue proneness, hazard monitoring and thrill seeking and were subsequently incorporated into the Driver Stress Inventory or DSI (Matthews, Desmond, Joyner, Carcary and Gilliland, 1997). Environmental factors may also affect the driver's ability to meet a goal, such as high workload previously considered for occupational drivers (Oz, Özkan and Lajunen, 2010), slower traffic, and poor visibility (Matthews, 2002). However, Matthews (2002) noted that a driver would not experience stress from these environmental factors alone due to their links to a belief, attitude or personal concern held i.e. the personality traits. Both these personality and environmental factors create a relationship for which stress can be the product (Matthews et al. 2005) as personal characteristics determine the extent to which both positive and negative emotions are experienced (Mesken, Hagenzieker, Rothengatter and de Waard, 2007). This was previously identified by Lajunen, Parker and Stradling (1998) who found that the strength of an emotion and personality attributes influence the outcome of frustration.

## 2.8 Frustration

Gulian et al. (1989, p598) remarked that stress was a combination of factors such as negative feelings, cognitions and behaviours and "*not least frustration and irritation provoked by the interaction with other road users*". The subjective state of frustration can affect individuals in different ways (Lee, 2010) and is considered a distraction (Burns and Lansdown, 2000), resulting from when a goal is interrupted by someone or something (Lee, 2010) and one which generates aggressive inclinations towards an individual considered to be the cause (Malta et al. 2011). Matthews et al. (2005) observed that when the traffic was considered frustrating it led to negative appraisal of the other road users as drivers developed subjective anger states and risky driving behaviours. Oz et al. (2010) noted that the Transactional model (Matthews, 2002) demonstrated how factors interacted dynamically with an interrelationship between those factors.

The link between frustration and aggression can be sourced back to early research by Dollard, Doob, Mowrer, Miller and Sears (1939). Shinar (1998) built upon this original work and suggested that aggression manifested itself as deliberate dangerous driving (not stopping at red lights, weaving through traffic) or as inconsiderateness towards another road user (tailgating, flashing lights, and using the horn). For those driving emergency vehicles, training may aid in reducing the feelings of frustration and subsequent anger as Lajunen et al. (1998) noted that those who have higher level safety skills were better able to mediate the effects than those with lower safety skills. However, it was also reported by Lajunen et al. (1998) that courses designed to improve vehicle handling skills would not improve a driver's tolerance, merely their coping abilities to a situation.

Responding to an emergency may create negative emotions in the driver due to impeded progress (Malta et al. 2011) along with a decrease in their performance and ability to process information (Dorn et al. 2003). Both Malta et al. (2011) and Chapman and Walton (2013) described some of the sources of frustration including slow-moving vehicles, or a travel path blocked by other traffic. The frustration may, in some cases, lead to aggressive behaviour (Chapman et al. 2013) and Kinnear, Helman, Wallbank, and Grayson (2015) reported that if drivers were unable to overtake due to limited passing opportunities and whilst under time pressure, they were more likely to become frustrated particularly at higher speeds (56mph compared to 40mph).

When negative feelings or emotions take over then frustration becomes a hazard to the emergency drivers themselves with Dorn et al. (2003) describing frustration as "red mist". Attention becomes significantly narrower due to the seeking of a specific goal at that moment (such as responding to a call) and, as a result, drivers may take more risks. The UK Ambulance Services Emergency Response Drivers handbook (DTAG, 2014 p13) also describes "red mist" as "*a term to describe a psychological state that can arise when drivers of emergency response vehicles are travelling at speed, focussing on what may be presented at the incident they are travelling to rather than their driving*". The Handbook (p13) adds that "*it can cloud one's ability to assess driving risks realistically*".

Lee (2010) studied driver's self-rated emotions and reactions to emotional situations using a driving simulator by setting a frustrating drive which utilised time pressure with a driving task accompanied by in-vehicle distractions. The drivers in the study were required to engage with a lead vehicle travelling at 5mph under the speed limit. The researchers found that the older drivers did not report feeling higher levels of frustration across any scenario but demonstrated a driving response indicative of frustration. The reasons were that the older drivers were better able to manage their emotions and adjust their behaviour more quickly. The Transactional Model of Driver Stress (Matthews, 2002) illustrated how these emotional states can lead to subjective states of anxiety and frustration as discussed but also lead to detrimental task performance including that whilst driving.

## **2.9 Frustration and occupational driving performance**

Chapman et al. (2013) assessed driver responses to frustrating events and found that frustration from a seemingly irrelevant task carried over to driving due to increased arousal. They observed that whilst this had only limited effect during simple driving tasks, difficult driving situations became more hazardous due to the narrowing of attention and lack of search for visual cues which links to the Yerkes-Dodson law (1908) described earlier in this literature review. The effect stress can have on emergency workers driving ability can be serious with Reiser and Geiger (1984) reporting that it can cause distortion with hearing, a disassociation with the environment and tunnel vision. The increased risks and demands of emergency response may create a loss of performance through stress (Drucker et al. 2013), leading to driver error, lapses in attention, and traffic violations (Wickens, Toplak and Wiesenthal, 2008).

Depending on individual personality but regardless of occupation, all drivers can be prone to stress. Professional drivers have stressors which may involve other drivers' behaviour (Evans, Johansson and Rydstedt, 1999), work scheduling and traffic congestion (Rowden, Matthews, Watson and Biggs, 2011). Matthews et al. (1999) reported that where a job involves driving for work then work demands could influence the driver's attitude and reactions towards driving so it makes sense it affects their perception. Specific groups of professional drivers, namely bus, truck and taxi drivers,

are reportedly more prone to stress reactions (Oz et al. 2010), when compared to other occupational drivers, with associated negative driving behaviours being increased speed and higher numbers of violations (Evans et al. 1999; Machin and Hoare, 2008). Conversely Oz et al. (2010) also suggested that professional drivers may get used to stressful situations so subsequently perceive them as being less risky as prolonged exposure leaves them desensitized to the hazards. This results in the drivers not perceiving the risks at the same level as others.

For emergency drivers who are responding, Christopher (2006) noted that response target times can be a major source of pressure to both Ambulance Trusts and their drivers. The same report by Christopher (2006) observed that it was not beneficial to compare the stress levels of Ambulance personnel to that of those in the Fire service due to their very different overall job roles, but the researcher did not consider driving as a separate factor. A study by James and Wright (1991) used questionnaires to examine stress within the Ambulance service. The main concern areas for the personnel involved were dealing with children, underuse of ability and being looked upon negatively by management. Later research, by Violanti and Aron (1994), asked Police participants to rank different stressors in order of effect felt using the 60 items Police Stress Survey. Respondents were asked to consider aspects deemed administrative (such as shift work, inadequate department support, incompatible partner and excessive discipline), along with those which were organisational factors (killing someone in the line of duty, aggressive crowds, court leniency and exposure to suffering). Of the 60 factors high speed chases ranked amongst the Officers as the 5<sup>th</sup> most stressful with collisions in a patrol car 10<sup>th</sup> in the rankings. Further research in 1998 by Beaton, Murphy, Johnson, Pike and Corneil considered the incident stressors for Fire service personnel. Using a list of 33 scenarios and incidents the personnel reported the death of a co-worker as the most stressful event, followed by injuries to themselves or someone known to them. A multiple injury motor vehicle collision was ranked as 10<sup>th</sup>, while the death of an adult from natural causes found to be the least stressful.

In the UK the HSE works closely with the emergency services to help manage risks appropriately. The HSE ([www.hse.gov.uk](http://www.hse.gov.uk/)<sup>4</sup>, p5) are however clear in their expectations that the Organisations should “*put in place all reasonably practicable steps to minimise those risks, including training, equipment and personal protective equipment*”. This includes the task of driving through “*appropriate training for Police Officers and other staff who need to take risk-benefit decisions in the course of operational policing*”.

For a highly trained emergency driver (Dorn et al. 2003; Dorn et al. 2005), but who may have negative perceptions of other driver's ability (Gormley et al. 2008) or heading to a highly charged situation with a role to fulfil, then emotions and their management (Hsiao et al. 2018) play a greater part in influencing the outcome. Stress has been identified as having major implications not only for an organisation but for the individual themselves. Professional drivers and those from the differing emergency services can experience a variety of stressors which impact on their driving depending on how they manage or perceive the stressors, and this will be dependent of the coping mechanisms they employ.

## 2.10 Coping methods

The previous few paragraphs have considered stress and its effects but equally important is the ability of an individual to manage their emotions. The belief an individual has about their own capability to exercise a level of control is referred to as self-efficacy (Ajzen, 2002). Further, locus of control considers individual differences between an action and its perceived outcome (Rotter, 1966; Parker, Manstead, Stradling, Reason, Baxter, 1992). Locus of control is linked to driver stress as those with high internality feel able to deal with a situation and is dependent on their own behaviour but those with external beliefs (externality) consider themselves at the mercy of chance or others (Gulian et al. 1989; Huang and Ford, 2012). A meta-analysis study by Arthur, Barrett and Alexander, 1991) reported that those with higher externality and lower internality were more likely to be involved in a collision due to being higher risk takers (Phares, 1978). Iversen and Rundmo (2002) also observed that individuals with higher internality reported less anxiety whilst driving.

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<sup>4</sup> HSE *Striking the balance between operational and health and safety duties in the Police Service: An explanatory note* [Online, p5] <http://www.hse.gov.uk/services/police/assets/docs/explanatory-note.pdf>

It is possible that risk perception varies according to experience where those who are more experienced are likely to be more realistic than those with less experience (Kouabenan, 2002). Brown and Groeger (1988) had previously reported that inexperienced drivers were more likely to underestimate the risks in traffic and overestimate their own driving skills but equally Dorn et al. (2003) found that Police drivers, and in particular those of an Advanced driving grade, had a sense of invulnerability, with crashes an accepted part of the role. This latter research by Dorn et al. (2003) did not corroborate that reported by Kouabenan (2002) who found that Highway Patrolmen in the US reported feeling the most fearful of a road accident and overestimated their own role in causing a road death when compared to that of a professional or civilian driver.

Training interventions have been found to aid an individual's ability to cope in an adverse situation (Huang et al. 2012). Coping mechanisms are individually developed reducing collision probability with further influence from driving experience and learned behaviour developed through schemas (Bartlett, 1932; Ghosh et al. 2014) discussed earlier in this chapter. Equally Iversen et al. (2002) found that large group training interventions were ineffective as they are not directed at individuals, or specific personality types. Kohn (1996, p182) described the effectiveness of someone's coping as "*how well it fits the specific demands of the situation*" and how a person deals or copes with stress influenced by their personality (Kobasa, Maddi and Kahn, 1982), or individual differences which are complex and unique to every person and which have a strong bearing on the outcome of the drive. The driver may have ineffective strategies to deal with that stress because of their personality type (Mitchell et al. 1990; Salters – Pedneault et al. 2010), lack of training or organisational support (Anshel, 2000). Those considered to have personality traits which are considered high on aggression and neuroticism (Gulian et al. 1989) are less likely to be able to appraise a situation in a safe manner which in turn can affect the outcome. The driver's ability to cope may transform itself into a state such as anxiety, known to cause a narrowing of vision (tunnel vision), lapses in concentration, lower decision-making skills and reduced situational awareness (Wickens, Hollands, Banbury and Parasuraman, 1992). The increased mental workload will ultimately affect attention and potentially cause crashes (Brookhuis et al. 2003a).

A coping method identified within the Ambulance service was that personnel prepared themselves on the way to a critical event by holding an “inner dialogue” (Avraham, Goldblatt and Yafe, 2014). It was found to aid in overall driving alertness and help drivers feel more able to deal with the stress. Specialist training for emergency or “Blue Light” drivers should make them more proficient at this method, but individual differences (Salters – Pedneault et al. 2010) may have more of an influence than training. As Dorn et al.(2003) noted there is no guarantee that training skills will be used whilst on response, with a driver often reverting to type.

It is critical for organisations to design solutions to manage the stressors that are relevant to the individual, and that are effective, as some feel that it is not appropriate to disclose feelings (Haslam and Mallon, 2003). In the last few years’ organisations have realised that they have a responsibility towards their workers both legally and morally with the health benefits of managing stress widely researched. Workers who are off through sickness and illness are a huge cost financially with replacement staff required, lost productivity, and unused training. The Health and Safety at Work Act (1974) s2(1) states “*it shall be the duty of every employer to ensure, so far as reasonably practicable, the health, safety and welfare at work of all its employees*”. This obligation in legislation includes the minimising of the risks of stress related illnesses or injury to employees. Occupational health departments now assist workers, either via individual requests or through referral from supervisors and managers. It is crucial that managers recognise the signs, are willing to take the issue seriously and listen, and then act without workers fear of being discriminated against, or confidentiality breached (Halpern, Gurevich, Schwartz and Brazeau, 2009).

Workers may often use the relaxed environment of the rest rooms, talking to peers where they use what is described as “Gallows” or “Black humour” (James and Wright, 1991; Alexander and Klein, 2009). Black humour is described as “*a humorous way of looking at or treating something that is serious or sad*” and making light of it to ease tension or anxiety (Cambridge Dictionary<sup>5</sup>). Alexander and Walker (1994) found it was the most frequently used coping method in their study of Police Officers and importantly was an effective coping mechanism (Melby, 2001; Scott, 2007) to relieve

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<sup>5</sup> Cambridge Dictionary [Online] <https://dictionary.cambridge.org/dictionary/english/black-humour>

stress (Melby, 2001) through allowing a release of emotions (Halpern et al. 2009). It is accepted practise amongst workers, and it has been found to unite the workers in a shared experience (Meyer, 2007) with the camaraderie reinforced between them through laughter and understanding (Palmer, 1983). The benefits of this type of humour should not be underestimated and is acknowledged as a cathartic release (Scott, 2007).

Consideration has been given to various stress triggers and how an individual may cope by deploying various strategies. Poor coping mechanisms can negatively impact on a driver's ability to perform, such as through narrowing of vision (Wickens et al. 1992), and a lower tolerance or patience (Brown, 1994), in some cases of other road users. A reaction to a situation will vary upon the individual but one possible outcome is that of "panic" which is considered further in the following paragraph.

## 2.11 "Panic"

The word 'panic' has become widely used within everyday language (Quarantelli, 2001) with various applications as to its true meaning. Dictionaries use a variety of descriptions, with the English Oxford Dictionary ([www.en.oxforddictionaries.com](http://www.en.oxforddictionaries.com)) defining it as "*a frenzied hurry to do something*" and a "*sudden uncontrollable fear or anxiety often causing wildly unthinking behaviour*". The Collins Dictionary ([www.collinsdictionary.com](http://www.collinsdictionary.com)) however says that "*panic is a situation in which people are affected by a strong feeling of anxiety where they act quickly and without thinking carefully*". There is clearly no one single definition to the word "panic" as it depends on the situation to which it is applied. A review of an online Thesaurus describes alternatives such as fear, alarm, horror, terror, anxiety, dismay, hysteria, fright and agitation of which only some may be appropriate in this instance.

For a civilian driver, some research has considered their reaction when attempting to ease passage of an emergency vehicle. Several published research studies have described a civilian driver's reaction as seeming to "panic" (Caelli et al. 1980; Gormley, Walsh and Fuller, 2008; Nakatani, Suzuki, Sakata and Nishida, 2009), Saunders et al. (2003) reporting instant panic reactions, whilst Drive (2008) talked about driver confusion although naturally wanting to assist. As previously discussed in Chapter 1

the UK Highway Code offers limited advice to drivers when dealing with an approaching EV and states “*when one approaches do not panic*” (Rule 219). Much of the published research, surrounding emergency service drivers has focussed on resulting collisions and causation factors (Custalow et al. 2004; Lambert, 2016). What this however does not show are the numerous civilian and emergency vehicle interactions that occur daily without physical incident causing only near misses, unsafe acts or no adverse event as discussed in Chapter 1.

Some research has considered this gap. Burke et al. (2001), as part of a wider study into understanding Fire Service crashes, used training documents, interviews, and an observational approach. It was designed to directly study the behaviour of Fire Appliance drivers, key risk situations and environmental influences. They gathered data which included whether sirens were on or off and how the Fire Appliance interacted with civilian drivers. They concluded that many civilian drivers were unsure of the action they should take, and remarked they appeared anxious or stressed, although this was not validated. The researchers recommended a greater public awareness of a proper response.

A later study, using self-report questionnaires by Saunders et al. (2003) focused on Ambulances using emergency warning systems. The researchers reported that the emergency vehicle may cause civilian driver stress due to the flashing lights and be deemed intimidating, due to the sirens, resulting in the civilian showing instant panic reactions. Saunders et al. (2003) also found that 50% of the civilian drivers in their study reported that they themselves had previously moved their road position suddenly due to an approaching Ambulance. The same study found that a significant 91% of all civilian respondents believed that they had however acted appropriately. This contrasts with 95% of Fire service drivers who believed that the drivers panicked upon seeing an approaching emergency vehicle (Gormley et al. 2008). The US Fire Administration (2014a, p39) reported that many civilian drivers did not immediately give way to an approaching emergency vehicle. However, once they were aware of the situation “*the civilian driver may panic and make an unpredictable movement or freeze and come to a complete stop wherever he or she is*”. Rogsch, Schreckenberg, Tribble, Klingsch, and Kretz (2009) conducted an overview of the definition of panic and distinguished between mass and individual panic. They reported that individual

panic occurred where there was an individual response which was unique to that individual without triggering a reaction which was similar in others.

Situations where groups of people may be affected by mass emergency situations, such as fires, has been an area of a specific body of research (Rogsch et al. 2008; Stedmon, Lawson, Lewis, Richards and Grant, 2017). The idea of a large body of the public becoming overwhelmed has limited association in this thesis as the drivers are not facing life threatening emergencies in group situations. Whilst drivers may copy others in terms of their actions it, in this case, relates to individual actions as discussed by Rogsch et al. (2008). Some researchers have applied the term “panic” directly to driving as detailed above but have not expanded on its real definition or application (Caelli et al. 1980; Saunders et al. 2003; Drive. 2008; Gormley et al. 2008; Nakatani et al. 2009) and simply used it as a passing comment regarding unpredictability (Dorn et al. 2003).

It has been reported that there was little substantiated research evidence on how drivers reacted when faced with a vehicle responding to an emergency (Solomon et al.1995; Tijerina et al. 2003). Solomon et al. (1995) stated that once a driver had noticed the emergency vehicle, they should take one of two courses of action. The first was to only recognise the hazard or be able to recognise the specific type of emergency vehicle and then secondly determine what would be the best course of action. Solomon et al. (1995) noted that the correct course of action would however depend on the situation faced. For the purposes of this thesis, “panic” was used in the driving context and to describe an unpredictable reaction by an individual driver.

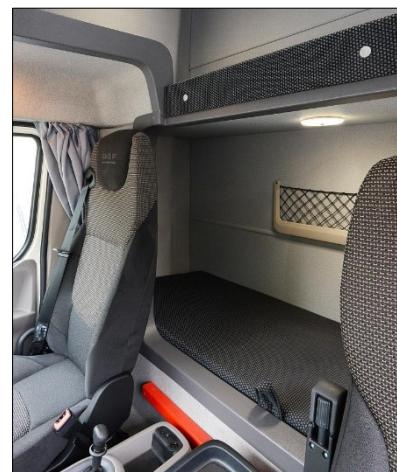
As shown many published research papers have attempted to define the word panic but equally have used it in a more general context to describe someone’s driving reaction. The action a driver makes may be linked, in part, to the type of vehicle they are driving, as it may restrict vision at various stages of the emergency vehicles approach. This is particularly the case for commercial vehicles which are considered in the next section.

## 2.12 Vehicle design and environment

Due to their design commercial vehicles such as Vans, Buses and Heavy Goods Vehicles (HGV) do not have internal rear view mirrors fitted leaving the driver more reliant on checking the side mirrors (Southall, Tait and Walsh, 1998) to gather traffic information behind. Larger commercial vehicles designed to carry cargo, also do not have rear passenger compartments, so the driver is protected from the rear of the vehicle by a fixed barrier screen or bulkhead. This bulkhead is designed to restrict a load from moving forward in the event of a harsh braking event as shown in Figure 2.14 and 2.15.

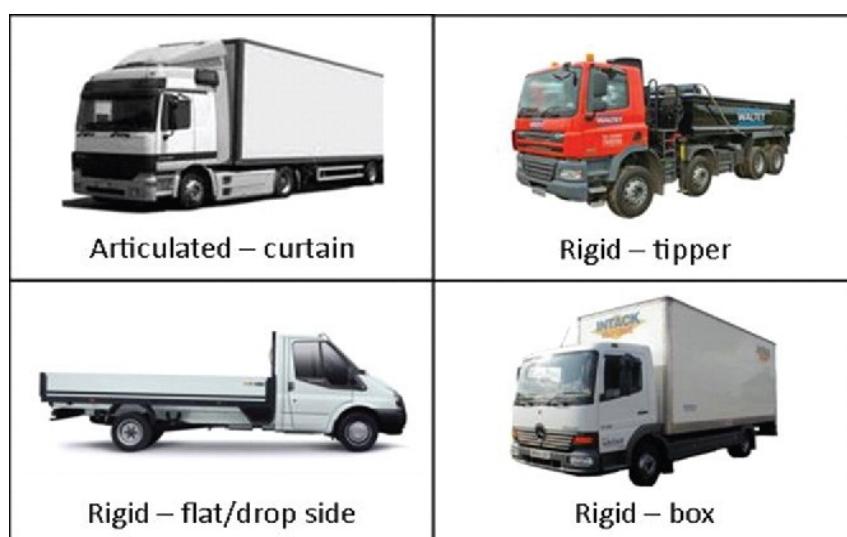


**Figure 2.14:**  
Example of a Bulkhead fitted in a Van



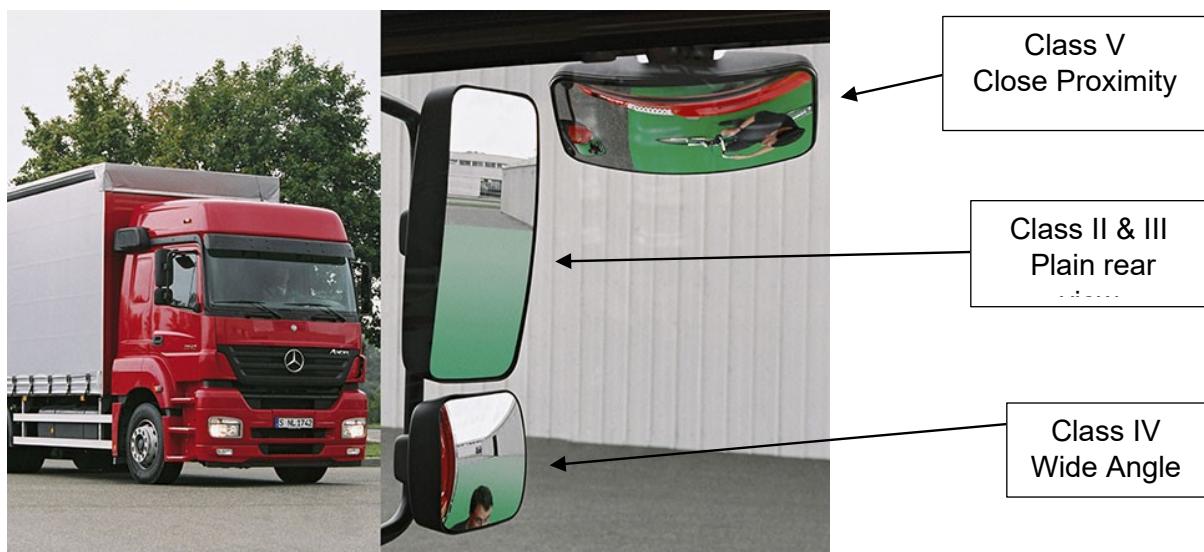
**Figure 2.15:**  
Example of a Bulkhead fitted in an HGV

Sivak (1996) noted that both vision and hearing were required to identify when a Police vehicle with emergency lights and sirens was following a car, thereby making identification more difficult in a larger or commercial type vehicle (Figure 2.16).



**Figure 2.16:**  
Truck Body styles  
(Talbot et al. 2017)

Drivers of a large vehicle such as an HGV must adapt their driving due to the existence of significant blind spots. These blind spots are essentially where the field of vision cannot extend to, despite the fitting of angled side mirrors, known as Class IV (wide angle rear view mirror) and Class V (side close proximity mirror) - (Cook, Summerskill, Marshall, Richardson, Lawton, Grant, Bayer, Lenard and Clemo, 2011). A Class II mirror (large door mirror) has previously been required to extend to an area just 2.5 metres parallel to the side of the vehicle which would mean the driver of a large vehicle may not see a smaller vehicle approaching into that space (Southall et al. 1998). EU regulations (46) were updated in 2014 and this distance has been further extended to 5 metres ([www.eur-lex.europa.eu](http://www.eur-lex.europa.eu)) but are not required to be retrofitted. The location of mirrors fitted to an HGV can be seen in Figure 2.17 below.

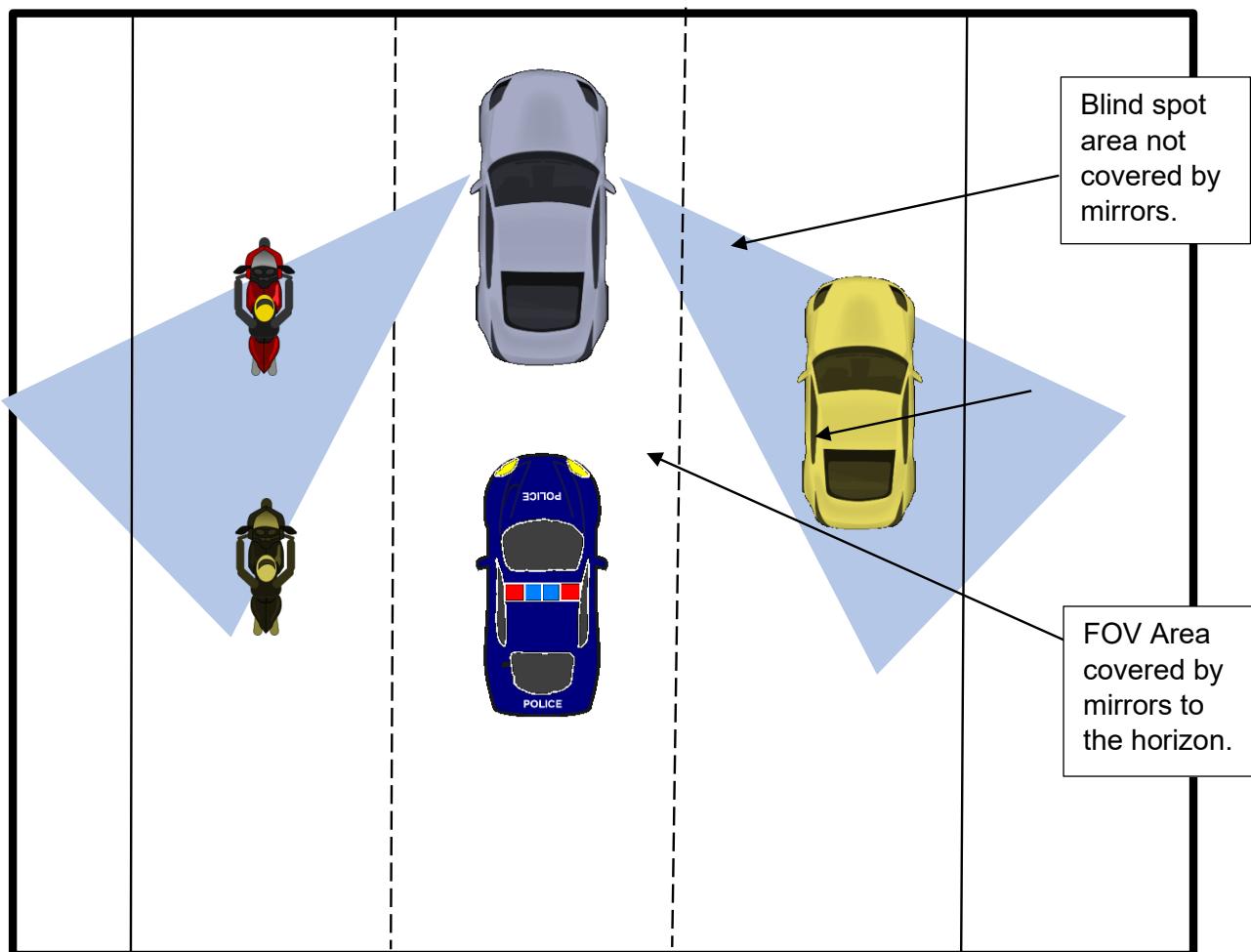


**Figure 2.17: The location and fitting of mirrors on a large commercial vehicle**

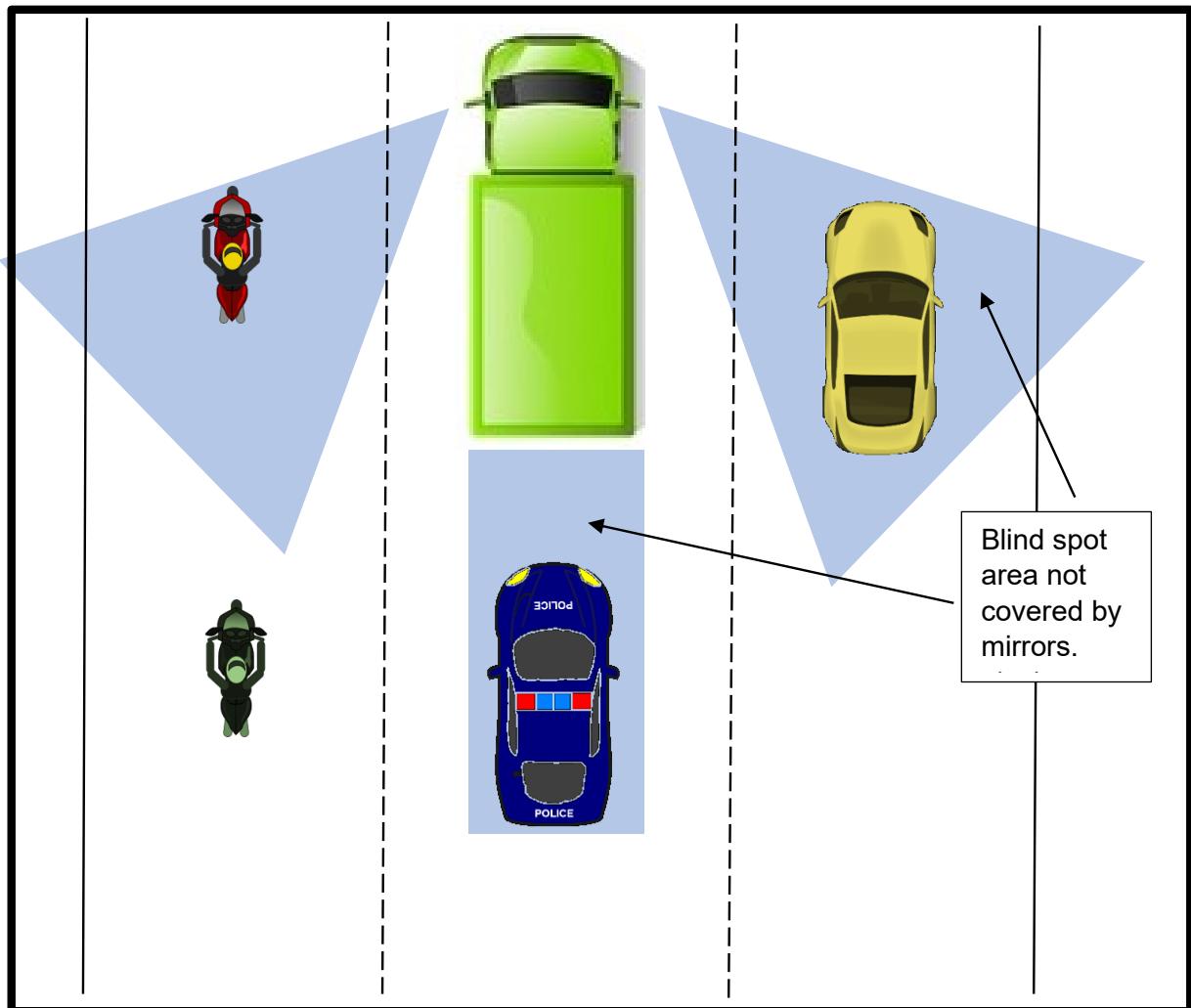
Furthermore Southall et al. (1998) gathered questionnaires from drivers and operators with drivers identifying poor vision, the offside (right) mirror not providing enough view of the road or approaching traffic from behind and the overall lack of vision to the rear. HGV operators reported issues surrounding restricted vision to the left, and drivers' mirrors being incorrectly set and adjusted. It was observed by Triggs and Harris (1982) that if a driver's eye height were reduced then it would limit the drivers sight distance, confirming the importance of correctly adjusted mirrors to account for individual driver characteristics. For a driver to complete a full set of observations using mirrors, at junctions, would take on average 5 seconds (Cook et al. 2011).

Cook et al. (2011) also identified that the poor setting of mirrors would reduce the area of vision thereby increasing the blind spot areas with Talbot, Reed, Christie, Barnes and Thomas (2017) noting, anecdotally, that truck drivers consider the Class V and VI mirrors only for parking and manoeuvring so may not be using them efficiently. The Class VI mirror sits over the front windscreen to cover the area immediately in front of the vehicle.

The illustrations below show the extent of the areas where the field of vision extends to, leading to blind spot areas for the driver of a car (Figure 2.18) and for the driver of an HGV or large commercial vehicle (Figure 2.19).



**Figure 2.18:The blind spot areas surrounding a car**  
**(Adapted from Marshall and Summerskill, 2017)**



**Figure 2.19: Blind spot areas surrounding a large commercial vehicle (ref [motorcycletesttips.uk](http://motorcycletesttips.uk))**  
**(Adapted from Marshall and Summerskill, 2017)**

For a car-derived vehicle both side and rear view mirrors can be relatively easily adjusted with only a limited amount of rear vision being compromised by internal fixings such as head restraints (Cook et al. 2011). The vision restriction to the rear of a car can vary between 6.5m and 10m on the ground plane and between 0.5 – 1m above the ground. For a van type vehicle, the rear vision is extremely limited where there is no rear window (Figure 2.20). For a van where there is a rear window the object behind would need to be at least 1.8m tall to be seen but the fixings or load would restrict this further (Cook et al. 2011).



**Figure 2.20: Illustration of the differing types of van doors restricting vision**

Considering the vehicle, environment and driver issues together highlights that the mirror setting should be individual. This is based on height and seat adjustment, weather and lighting conditions which may be detrimental to vision due to glare or reflection, and driver performance affecting the frequency of the mirror checks themselves.

Due to the larger size of a commercial vehicle, when compared to a car, the vehicle will physically take longer to accelerate, decelerate or to take evasive action (Missikpode et al. 2018) with the US Fire Administration (2014a, p36) also noting that larger vehicles were less stable, equally applying to Ambulances and Fire Appliances (Missikpode et al. 2018). By nature of its larger size an HGV or Van may restrict the view of lights and signals at a junction for a responding emergency vehicle (Clarke et al. 2009) and the larger emergency vehicles may also adversely affect the vision of adjacent road users who may be next to them (Hsiao et al. 2018). Clarke et al. (2009) found that van drivers were involved in more collisions than car drivers as they had not taken into consideration the restricted view. The larger vehicle will be, however, easier to detect for other road users but they may find it more difficult to be able to judge speed and length (Hurt, Ouellet and Thom, 1981). When comparing liability of those involved in a collision and driving for work, cars, vans and HGV's were more likely to be at fault whereas buses, taxis and emergency vehicles were in collisions where the other party was more likely to be to blame (Clarke et al. 2009).

The literature review has shown that different vehicle types present the driver with challenges, perhaps not present for a car driver. Principally the view a driver may

have from a larger commercial type vehicle will be restrictive, despite several mirrors being required. Lal and Craig (2001) found that professional HGV drivers were at a high risk of driving fatigue due to heat, noise and vibration in the vehicle cab. As such the vehicle type, and indeed road type may be a contributing factor into how that reaction occurs and this is considered in the next section.

### **2.13 Road monotony and fatigue**

The environment, whether internally or externally to the driver, and road type itself can contribute to the decrease in driver alertness and may increase fatigue, as is the case of high speed roads such as Dual Carriageways and Motorways (Langham et al. 2002; Pastor, Tejero, Chóliz and Roca, 2006). Driver fatigue is known to cause the slowing of driver reaction times (Phillip, Taillard, Klein, Sagaspe, Charles and Davies, 2003) alongside poor detection of signals, drifting across lanes, inaccurate steering (Thiffault and Bergeron, 2003), poor observation of a secondary object (Matthews et. al. 2002) and lack of situational awareness (Czeisler and Gooley, 2007). These monotonous high speed roads can cause individuals to drive on autopilot and lapse into a state identified by Williams (1963) as "highway hypnosis" resulting in a diminished ability to be able to both detect and react to a sudden situation (Pastor et al. 2006). This phenomenon is less likely to happen on urban or unfamiliar roads due to the increased stimulus and the need for raised attention (Pastor et al. 2006). However, Dyani (2007) suggested that whilst in a highly demanding situation the driver suffered with active fatigue due to the overload of information. Dyani (2007) also noted that on monotonous roads and where there was low stimulation demand the individual suffered with passive fatigue.

Driver fatigue was found to be a significant contributory factor in crashes amongst professional drivers (Thiffault et al. 2003; Strahan, Watson and Lennonb, 2008; Clarke, Ward, Bartle and Truman, 2009) whether in a car or commercial vehicle. Further Horne and Reyner (1995) estimated that fatigue may account for 23% of fatal crashes on monotonous roads but acknowledged that drivers often deny falling asleep whilst driving.

Driver fatigue affects both emergency drivers and the other road users they interact with who may also be suffering the effects of fatigue. Pinizzotto, Davis and Miller (2002) observed that speed or fatigue may be a collision factor where shifts were involved together with the job role itself at the time of the collision. Studies have established that crashes, where fatigue was an identified factor, were more likely if individuals were working several jobs, unusual work schedules and shift patterns or had broken sleep (Stutts, Wilkins, Osberg, Vaughn and Bradley, 2003). Horne et al. (1995) observed clear links to a vehicle collision and time of day with the peak collisions occurring between 02:00 – 06:00 and 14:00 – 16:00. To explain this finding Clarke et al. (2009) evaluated crashes involving those deemed professional drivers and were either driving a Heavy Goods Vehicle, a company car, emergency vehicle, taxi / minicab or a bus. Those driving HGV's were found to be involved in the highest incidents of fatigue type collisions and this was in the early hours of the morning and early afternoon. This would correlate with an individual's natural sleep pattern known as the circadian rhythm (Czeisler et al. 2007) and an individual's natural body clock which follows a rhythm over 24 hours (Dobson, 1982). This pattern was confirmed in the Horne et al. (1995) study, as crashes were occurring when the circadian rhythm indicated natural sleepiness.

An additional risk for professional drivers and those who commute for work is that they are likely to be driving the same roads every day and as such become familiar with them (Young, Mackenzie, Davies and Crundall, 2018). The repetition can cause a decrease in awareness of the road situation particularly if the road is straight, everyone is travelling in the same direction (Langham et al. 2002), and as such events go unnoticed (Charlton and Starkey, 2013). It has been suggested that the freeing up of the cognitive task of thinking about the driving itself allows attention to be diverted elsewhere such as spotting hazards (Charlton et al. 2013; Pradham and Crundall, 2017) but may move equally to inward thoughts (Berthié, Lemercier, Paubel, Cour, Fort, Galéra, Lagarde, Gabaude and Maury, 2015; Burdett, Charlton and Starkey, 2018).

Driver fatigue, as discussed, has been found to be a significant risk to drivers and those considered to be professional through the vehicle they drive, their choice of occupation and time on task (Lal et al. 2001). Whilst the driving of large commercial

vehicles is highly regulated in respect of driving hours (Horne and Reyner, 1999), for all professional drivers there may be a feeling of a higher skill level compared to other road users, discussed below, perhaps due to greater degrees of training or the drivers believing negative events happen to others (Dalziel and Soames Job, 1997).

### **2.14 “Better than Average” effect**

Individuals naturally want to be perceived as better than others and can hold a sense of superiority over their driving skill and safety (DeJoy, 1989; Glendon, Dorn, Davies, Matthews and Taylor, 1996) when comparing themselves to other drivers. Drivers will rate their own ability through comparing to others and try to find the positives in themselves by filtering information they deem important regarding ability. Yet whilst most rate themselves as superior it is not possible for most people to be better than the majority of others (Weinstein, 1980; Taylor and Brown, 1988). Lajunen et al. (1998) found that drivers with a higher self-view of their own skilfulness would be affected in their own driving style in relation to safety. The study by Waylen, Horswill, Alexander and McKenna (2004) asked both expert (had passed an Advanced Police driving course) and civilian drivers to rate their own ability with someone of the same expertise. Each group rated themselves as superior showing expert drivers were just as likely to be susceptible to such beliefs as novice drivers. The questions used covered 18 different attributes but specifically described driving skills, rather than behaviours, and the items considered can be found in Figure 2.21.

Maintaining appropriate speed for the conditions	Smooth cornering	Appropriate use of signals
Proper use of mirrors	Knowing when to overtake	Knowledge of the Highway code
Awareness and anticipation of pedestrian activity	Awareness of own fitness to drive	Controlled emergency stops
Monitoring of junctions / bends	Appropriate use of gears	Awareness / anticipation of other road users' behaviour
Reversing / Manoeuvring	Adapting to conditions	Maintaining appropriate following distances
Merging with traffic / changing lanes	Hill starts	Parking

**Figure 2.21: Driving skills assessed between Police and non-emergency drivers (Waylen et al. 2004)**

The concern is that those drivers who deem themselves to be more skilful may engage in riskier behaviours when driving (Wohleber and Matthews, 2014). This can be particularly true of young drivers who, despite being disproportionately represented in crash statistics have been found to rate themselves as equal in risk to older more experienced drivers (Matthews and Moran, 1985). This is then reinforced as they may see others doing the same and seemingly getting away with it.

If overconfidence can lead to risky driving (Waylen et al. 2004), then those within the emergency services may be at even greater risk as they are using their training and skill to engage in manoeuvres that may not be appropriate (USFA, 2002). Passing a skill based driving course may give the drivers an overestimated sense of their own ability and therefore invulnerability (Dorn et al. 2003). This sense of invulnerability was previously noted by Pinizzotto et al. (2002) who found that Officers were more likely to suffer a level of invincibility having carried out their role successfully for several years. An alternative view was put forward by Waylen et al. (2004) who said that some people who rate themselves as above average may be genuinely so. This would particularly be the case with expert drivers when compared to an average driver such as those working in the emergency services. However, if an expert driver was compared to another expert driver in the same field, they were unlikely to be better, but they could still rate themselves as superior drivers. It is perhaps important to note that individual differences and personality affect the extent of how much we rate ourselves above the average. Brown (1986) found that an individual with higher self-esteem would rate themselves more favourably when compared to others than for those with lower levels of self-esteem.

It has been reported above that Advanced Police drivers are more susceptible to a sense of invulnerability (Dorn et al. 2005) and displayed a sense of invincibility (Pinizzotto et al. 2002). This would imply they are more prone to risk taking, despite training attempting to aid the management of such feelings. The training will ensure that the increased demands on emergency drivers to not only handle a vehicle at higher than average speeds but negotiate the environment and other road users are to a standard as defined by the College of Policing (College of Policing<sup>6</sup>). Drivers

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<sup>6</sup> Police Driver Training Governance. <https://www.app.college.police.uk/wp-content/uploads/2016/05/Road-policing-Police-Driving-Governance-v6.pdf>

therefore must ensure they are aware of where those demands may emerge from, considered below.

## 2.15 Mental Workload

Driver demands may take the form of an increased mental workload and was described by Jahns (1973) as being broadly influenced by input load (environmental, situational and procedural), operator effort (through personality, motivation, experience and attentiveness) and finally performance (response time and error likelihood). Performance was taken as measure of the drivers spare mental capacity and was later summarised as the cost incurred by an individual, whilst achieving a defined performance level on a task with specific demands (Hart and Staveland, 1988). Capacity itself is considered to be “*the total quantity of attention that can be used for processing*” (Matthews, Davies, Westerman and Stammers, 2000 p 87). As with previous discussions in this Literature review, workload can be influenced by how an individual perceives the tasks against their own capacity to be able to carry them out (Eggemeier, Wilson, Kramer and Damos, 1991; DiDomenico and Nussbaum, 2008).

Wickens (2008) observed that mental workload focused principally on demand from a stimulus. He therefore developed what became known as the Multiple Resource Theory as he noted that individuals drew from a pool of resources to allow them to conduct a number of tasks simultaneously without a performance deficit. He reported that the resources for a task could be drawn from different pools according to the stage of processing but also according to modality such as visual or auditory. He developed a model (Figure 2.22) to show how the stages (Perception, Cognition, Recognition, codes (Spatial, Verbal) and modalities (Visual, Auditory) can be used to predict mental overload.

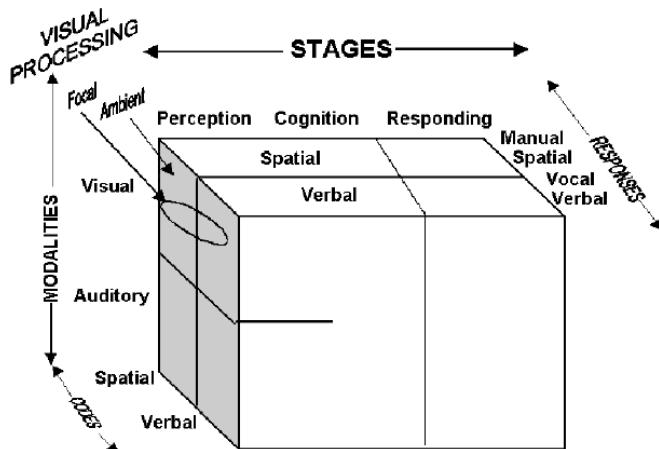


Figure 2.22:  
4D Multiple Resource  
Theory Model  
(Wickens, 1980)

Moray (1979) had previously reported that demand was an individual's limited mental resources being allocated to the task. Wickens and Holland (2000) later stated that if task demand were less than the resources available there would be unused capacity, should an unexpected driving event occur. However, if resource demands were greater than the capacity, in a particular pool, there would be a reduction in performance (Kahneman, 1973). Latter research has challenged this (Dijksterhuis, Brookhuis and De Waard, 2011) finding that mental workload cannot be assessed based on performance alone, as an individual may choose to accept a lower performance standard.

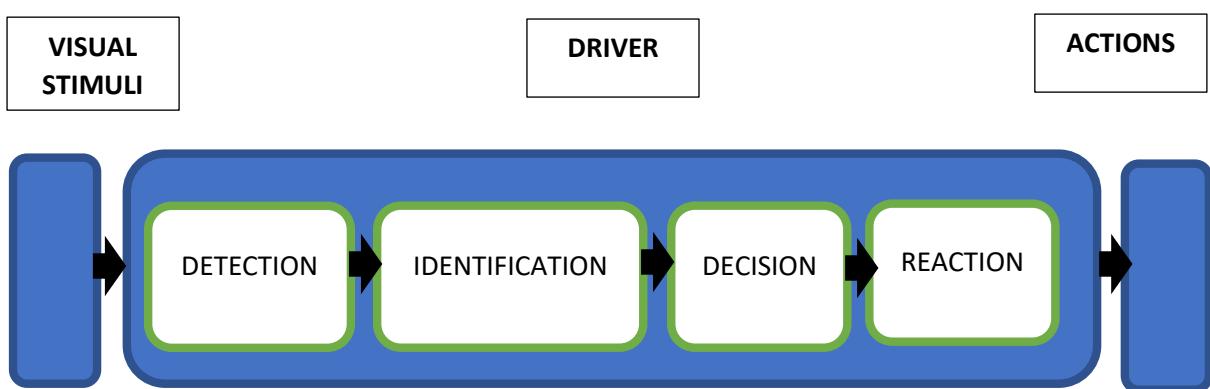
In a driving situation it is possible that when demand is low (such as on long, monotonous motorways) performance needs to be high to concentrate to avoid a decrease in vigilance. Conversely in a high demand location such as an urban area then as workload increases it leads to overload and lowered performance (Paxion, Galy and Berthelon, 2014). This is due to the required resources exceeding the available resources (Robert and Hockey, 1997). Driving requires concentration on several tasks (primary and secondary) for it to be carried out safely but more experienced drivers conduct some tasks subconsciously (Williams, 2003) thereby freeing up resources for other non-driving activities such as distractions.

Distractions can be classified as external objects and events or internal from thoughts and cognitive activity (Posner, 1980; Recartes and Nunes, 2003). Engaging in these secondary tasks, unrelated to driving, may subsequently affect decision making and incorrect or late responses (Recartes et al. 2003). Recartes and Nunes (2000) found that an increase in workload had a detrimental effect on visual scanning span, inspection frequency of mirror and speedometer checks, and speed itself. Additionally, experience is known to be linked to visual processing in that novice drivers conduct fewer mirror checks and scan a narrower area than their more experienced counterparts to limit the visual input and manage processing demands (Crundall and Underwood, 1998). Highly experienced Police drivers negotiate a heavy cognitive workload as part of their role which can include communication, time pressure, route planning and memorising information (Gandolfi and Dorn, 2003) leading subsequently to reduced concentration, risk taking and increased collisions. The evidence shows that drivers who are prone to higher mental workload will

experience lower levels of visual scanning, longer reaction times and a reduction in performance. This will be considered further in the following sections.

## 2.16 Visual processing

As already discussed, driving is a complex task relying on an interaction between the driver, vehicles and the environment (Sivak, 1996) for it to be completed safely with drivers utilising both psychomotor and cognitive skills such as decision making, attention and information processing (Keskinen, 1996). It has been suggested that information gathered by a driver is 90% visual (Kline, Ghali, Kline and Brown, 1990; De Lorenzo et al. 1991; Sivak, 1996), with vision described as the principal sensory channel for a driver to make decisions (Cole, 1972) but the usefulness of this information can be degraded by a variety of factors which affect a driver's performance. For a driver to perform safely they must first observe the hazard, process it and then decide and act with an appropriate response (Olson and Farber, 1996; Crundall, Underwood and Chapman, 1999; Cook, Summerskill, Marshall, Richardson, Lawton, Grant, Bayer, Lenard and Clemo, 2011). The four steps identified by Olson et al. (1996) were: i) an object must be detected as being in the driver's path; ii) identification that the object is a hazard to the driver; iii) a decision taken as to an appropriate action; and iv) the performance of the action through a driving manoeuvre. This is captured in Figure 2.23 below.



**Figure 2.23: Drivers Visual Processing**  
(Cook et al. 2011)

Individuals can identify an object, determine what it is and identify the object rapidly although interpretation of that object may vary (Mack, Gauthier, Sadr, and Palmeri, 2008). Thomas and Williams (2018) reported that providing a driver can identify that

something large is occupying the visual space they do not need to immediately identify it as a Police car. The driver can rely on their hazard perception skills rather than categorisation of a specific item such as an emergency vehicle. The colour of an emergency vehicle (Solomon et al. 1995) was considered earlier in this chapter and saliency or conspicuity within the visual field is an important factor as it captures attention. Olson et al. (1996) reported that drivers categorise the object in their visual field based on stored memory following the initial detection. However, this idea has been challenged with Thomas et al. (2018) suggesting that the driver uses the pre-existing memory of a Police vehicle by extracting the shape and outline features first and then matching that to the environment.

The ability for a driver to identify an emergency vehicle involves four processes as shown by Cook et al. (2011). The fourth stage, reaction, may be delayed by several factors which are considered within this literature review, such as vehicle type, fatigue or distraction. The agreement of what is an acceptable reaction time is looked at further in the next section of this chapter.

## 2.17 Reaction Time

Drivers with decreased alertness and a narrow field of view will inevitably experience longer reaction times (Lee, McGehee, Brown and Reyes, 2002), becoming an issue should a situation occur that requires some form of driver action. It will take longer to detect and process the information leading to a later reaction such as braking or moving lanes. The UK Highway Code assumes a driver can react in 0.7 seconds (Triggs et al. 1982) but these figures were calculated many years ago where there was less traffic on the road, vehicles were less automated with fewer in-vehicle distractions and the driver was assumed to be fully alert to their surroundings.

It raises the question of what is deemed a suitable reaction time for a driver as every situation is different (Green, 2000), as is every driver (Summala, 2000). Gao and Davis (2017) described reaction time as *“the time gap between the time point when leader vehicle’s brake light first went on and that when the following driver first swerved or braked, which ever came first, as the response to the leader driver’s brake”*. Earlier work by Olson and Sivak (1986) referred to reaction time instead as a Perception –

Response Time (PRT) to unexpected events as not all reactions need to be sudden and could occur due to an event from behind which is developing such as moving out of the way of an emergency Vehicle. Summala (2000) reported that a driver action need not be a reaction to brake lights but alternatively a steering response. Reaction time can be affected by many factors including being lost in thought, distractions from a secondary task such as talking, mobile phone use, or using the radio (Alm and Nilsson, 1995), age, gender and weather (Gao et al. 2017). In the study by Gao et al. (2017) they found that the primary cause of an increase in reaction time was driver distraction.

There is little agreement amongst researchers as to what is acceptable reaction time for a driver, and this would make sense as every driver is individual with many driver variables to be considered. Green (2000) reported that reaction times are in fact affected by expectation, urgency, age, gender and cognitive load and Makishita and Matsunaga (2008) found that reaction times were significantly affected by mental workload. The more difficult the task the greater the difference related to age. Several researchers have attempted to calculate reaction time with Taoka (1989) reporting that the acceptable reaction value for his study was 2.5 seconds but Probst, Krafczyk and Brandt (1984) found an average of 1.14 seconds and Chang, Messer and Santiago (1985) 1.9 seconds. Taoka (1989) concluded that 1.8 seconds was more representative of drivers. Triggs et al. (1982) found that a driver's ability to react to emergency signals showed reaction times of below 2.5 seconds. Langham et al. (2002) considered reaction times of drivers who were looking for a hazard ahead but potentially failed to identify them in time. For Langham et al. (2002) the hazards were stationary, compared to moving emergency vehicles, within the context of a simulator study rather than in the field. Indeed the published literature stated that "*None of the participants failed to respond to the parked car altogether, but it must be kept in mind that these participants were in alert state in which they were actively looking for hazards for a comparatively short period of time*". Langham et al. (2002) does not therefore provide a representative comparison for reaction time and the identification of emergency vehicles.

Makishita et al (2008) reported that whilst the effect of a task on mental workload has been largely confirmed, drivers themselves remain unaware of the effect that mental

workload has, compared to that of a physical or visual task applying equally to both civilian and Police drivers. Crundall et al. (2003) found that during a Police pursuit there was an increase in demand on the drivers' attention and visual search patterns required by the driver for hazard awareness. This is due to exposure to a sustained hazard such as driving at high speeds, close following behind another vehicle and the increased communication to colleagues. One issue that could affect Police driving is known as "inattentional blindness". Mack (2003, p180) described inattentional blindness as "*the failure to see highly visible objects we may be looking at directly, when our attention is elsewhere*". This phenomenon could become a factor in pursuits where the focus is on a single target, so it is important all drivers are aware of this and maintain active visual search (Mares et al. 2013). Crundall et al. (2003) commented that Police pursuit drivers are however the most highly trained on the roads, and as such the training should mitigate some of those risks.

## 2.18 Visual scanning patterns

In order to reduce the risk of targeted vision, as highlighted above, it is critical a driver maintains peripheral vision, known as "Field of view", and is described by Ball, Beard, Roenker, Miller, Griggs (1988) as "*the total visual field area in which useful information can be acquired without eye or head movements (within one eye fixation)*". This visual field is known to become smaller, due to decreasing alertness (Rogé et al. 2002a), with prolonged driving in monotonous situations (Rogé et al. 2002b) and when the driver is fatigued (Rogé et al. 2003). Additionally, Rogé et al. (2004) found that an older driver had a smaller field of view than younger drivers when on a Motorway. This can be crucial, as at higher speeds information is available for a short period of time in some cases due to the distance a vehicle can cover over time (Rogé et al. 2004).

Whilst an older driver may have reduced peripheral vision, they are more likely to adapt their search patterns to the road type more effectively than a novice driver (Crundall et al. 1998). Underwood, Crundall and Chapman (2002) found that an experienced driver would use the most relevant mirror and for longer when compared to a novice driver. This was confirmed in research by Mourant and Rockwell (1972) who reported that novice drivers had fixation patterns over a small area and often just in front of the

vehicle with infrequent side and rear-view mirrors checks being carried out. The experienced driver also has more varied horizontal scanning (that is side to side) on a dual carriageway over their novice counterparts (Crundall et al. 1998), with Chapman and Underwood (1998) noting that a driver may rely on the area of visual expansion for a scene as this provided the driver with important directional and hazard information.

Humans have a natural tendency to look towards a light or a specific object and as such drivers may steer towards it in a manner called the “moth effect” or phototaxis (Morgan, 1978; Younger, 1997; Solomon et al. 2002, p56; Vanderbilt, 2008, p279). The US Fire Administration (2014) noted that emergency drivers held a common belief of the existence of the “moth effect” but reports from Solomon et al. (1995) and Cook et al. (1999) could not find supporting evidence for the theory. Further research has found that it is not just the draw of bright lights but due to the lack of other environmental cues such as streetlights or buildings. This can make it more difficult for the driver to judge depth, speed of other road users, and location decisions (Solomon et al. 2002, p56). At night a driver may have to rely on fewer objects for directional information which could be lights ahead or vehicles travelling in the opposite direction. As such the driver may inadvertently steer right putting them at risk of a collision.

Being able to identify hazards to the side and rear field of view requires good peripheral vision from the driver alongside the frequency of mirror checks which is critical to the driving task (Pastor et al. 2006). Pastor et al. further reported that drivers on Motorways have been found to use their rear view mirror less but would subsequently then look ahead more often. The frequency with which a driver checks the mirrors to find traffic information and traffic changes (Pastor et al. 2006) has also been identified as an indicator of driver alertness (Brookhuis, De Vries and De Waard, 1991). Interestingly though when a driver’s mirror use was compared between Motorways and urban roads, interior mirror use was 10 times greater in checking frequency and the left mirror more than double in frequency (Recarte and Nunes. 2000; Pastor et al. 2006) whilst on a Motorway. This may be since there is minimal cognitive demand on a high speed road when compared to an urban environment, so the driver is able to use their mirrors more (Pastor et al. 2006). Konstantopoulos and Crundall (2008)

compared Driving Instructors and novice drivers to establish if they ranked different driving tasks and situations in the same way. For Motorways and Dual carriageways, the Instructors ranked the use of the rear view mirror higher than the side mirrors, but this difference was not evident in the novice drivers, further confirming that experience is important in driver safety.

The ability of any driver to be able to identify a hazard quickly is dependent of good observations, thorough mirror checks, alertness and peripheral vision as identified in the literature review. The alertness and cognitive demands on a driver, such as distraction or time pressure through work, may however limit their processing ability, causing delay in reaction.

## **2.19 Distractions and Time Pressure**

Drivers who are under pressure or distracted reportedly make more risky decisions (Young and Salmon, 2012) and subsequently undertake more risky manoeuvres. As such, a driver must process the available information in a short time frame with drivers only having limited processing capacity and resources (Ben Zur and Breznitz, 1980; Wickens, 1984). This degradation in processing decreases a driver's situational awareness (Kass, Cole and Stanny, 2007; Salmon, Stanton and Young, 2010) and negatively affect reaction times (Burns, Parkes, Burton, Smith, and Burch, 2002; Lee, Caven, Haake and Brown, 2001). Cohen (1981) commented that in his research a driver fixated longer on a photo than on a real driving scene due to the lack of time pressure within the laboratory setting.

Factors such as lack of attention, driver distraction and fatigue can play a significant part in reducing the ability of a driver to identify an initial hazard. Treat (1980) considered driver inattention to be the delayed recognition of information by a driver but who is required to complete the driving task safely with attention diverted elsewhere. Much later Hedlund, Simpson and Mayhew (2005, p2) developed a definition of distraction and described it as "*a diversion of attention from driving, because the driver is temporarily focusing on an object, person, task or event not related to driving, which reduces the driver's awareness, decision making ability and/or performance leading to an increased risk of corrective actions, near crashes or*

*crashes*". Hedlund et al. (2005) noted that impaired driving through alcohol or fatigue, whilst not a distraction alters the effect of another distraction due to personal characteristics but that distractions overall do not necessarily lead to an immediate consequence.

Later researchers disagreed with removing these impairment factors and believed that distractions could therefore take the form of visual, cognitive and physical, all of which remove attention away from the driving task (Lee, Young and Regan, 2008). Chapman et al. (2013) later described the types of distractions as "external" but coming from inside the vehicle (music, passengers) and those outside such as advertising boards. The "internal" distractions were such things as emotions, daydreaming and fatigue. Drivers with an increased cognitive load, be it from an internal or external source, have been found to have narrow vision, reduced detection of hazards and developing situations (Recarte et al. 2003), alongside less frequent checking of mirrors (Brookhuis et al. 1991). Strayer, Drews and Crouch (2006) found that drivers who were engaged in some form of driving distraction were more likely to be involved in a collision with an emergency vehicle.

Johnson, Voas, Lacey, McKnight and Lange (2004) found through observation that the use of a mobile phone whilst driving was the most common distraction, followed by smoking, eating, drinking, talking to a passenger and manipulating controls making up a significant proportion of the remainder. This contrasted with Stutts, Feaganes, Reinfurt, Rodgman, Hamlett, Gish, and Staplin (2005) who found that mobile phone use was just 1.30% of the time observed when the vehicle was moving but overall distractions accounted for 30% of the time. Numerous studies have looked at the effect of mobile phone use for example on the performance of a driver with an agreement that drivers react more slowly and miss safety cues such as road signs (Strayer and Johnston, 2001; Strayer, Drews and Johnston, 2003). Strayer and Drews (2007) subsequently noted that the use of a mobile phone drew attention away from the external environment and to the context of the conversation, with the consequences leading to reduced vigilance and poor awareness of the surroundings.

Drivers may be going through the process of checking mirrors or directing their gaze within the environment but are often unable to recall what they saw effectively (Strayer

et al. 2007). Voice activated technologies have now become more common in vehicles such as handsfree mobile phone use, but these have also been found to affect the behaviour and performance of a driver who spent more time looking ahead and less in the mirrors and peripheral areas (Harbluk, Noy, Trbovich and Eizenman, 2007). Similar effects have been found more recently from drivers who use navigational systems (Rogers, Zhang, Kaber, Liang and Gangakhedkar, 2011). Interestingly whilst Johnson et al. (2004) and Stutts et al. (2005) both considered passengers to be distractions, Charlton (2009) believed that a passenger could be an advantage due to being able to alert a driver to hazards.

Emotions, such as stress, frustration and fatigue have been shown to influence driver performance if they are not recognised or without the development of suitable coping strategies. As discussed, a large body of research has been developed which also considered the effect driver distraction can have on road safety. These distractions, whether visual, physical or cognitive may have an impact on mental workload for both emergency and civilian drivers. It has also been shown that modern vehicles provide a wide opportunity for drivers to engage in a secondary task, albeit mobile phone use, in built entertainment systems, navigation, (Lee et al. 2008; Chapman et al. 2013) alongside passenger distraction or vehicle comfort creating a seemingly protected environment, separated from the outside world (Caelli et al. 1980; De Lorenzo et al. 1991). This environment can result in civilian drivers not being aware of approaching vehicles operating warning systems in good time. The following research investigated how drivers and vehicle interact during an emergency response drive, whereby negative emotions may exist at a time of increased mental workload.

## Chapter 3: Pilot study and initial analysis

### 3.1 Overview

Emergency vehicle driving is a demanding task and requires a high level of awareness from the emergency drivers (Symmons et al. (2005). The higher than average speed and the nature of the call (Manser et al. 2005) alongside the environment itself (Custalow et al. 2004; Clarke et al. 2005) may increase the potential for feelings of stress. A review of the current literature found that civilians may be unpredictable (Dorn et al. 2003) or may panic upon the sight of an emergency vehicle (Gormley et al. 2008). Clarke et al. (2009) reported that civilian drivers were the cause of crashes due to failure to observe signals and that a slow moving vehicle may lead to annoyance or frustration (Trick et al. 2012). The literature also suggests that emergency drivers have a perception that civilian drivers, whilst a source of frustration to them, may also be the cause of crashes and require better education or training on how to drive when the EV was passing.

Importantly Lajunen et al. (1998) observed that a driver who was safety orientated, in this case emergency drivers were less likely to allow their anger or frustration to affect their driving behaviour. The researchers observed that this may be because those with extensive and particular driving experience have learned to adjust and can better tolerate frustrating driving situations. Hsiao et al. (2018) noted similar findings in that experienced drivers were better adapted to manage stress and time pressures.

This chapter describes a quantitative pilot study to evaluate whether Police response drivers report increased stress and frustration levels whilst responding to emergencies, the adaptive coping mechanisms they use, their view on how civilians' drive and the perception of their own skills. The research question is addressed as follows;

### 3.2 Research question

**RQ1:** Do the Police, Fire and Ambulance service emergency drivers report similar levels of frustration, and have the same perceptions of civilian driving, whilst they are on an emergency response?

In order to investigate the research question, four areas were identified which would assist in gaining a deeper level of understanding across each of the driving scenarios. These categories formed the basis of each question selection for the questionnaires.

- *Police Driver's perception of their own risk and capability when compared to others.*
- *Police Drivers feelings and emotions when driving under emergency versus ordinary (non-emergency) conditions*
- *Police Drivers attitude towards civilian drivers under ordinary traffic conditions*
- *Police Drivers attitude towards civilian drivers when interacting with an emergency vehicle on response.*

### 3.3 Methodology

The intended purpose of the Pilot study was to test the proposed methodology for Study 1 of this thesis. Several research methods were initially considered which included focus groups, interviews and questionnaires. It was recognised that focus groups allowed participants to use their own words and this approach could therefore yield rich and detailed data, which would not be derived through other methods. However, they could also be time consuming (Robson, 2011, p294) lasting typically between one and two hours which required the participants to give up valuable time. Work patterns amongst professionals also made this a difficult approach. Furthermore, focus groups are not designed for high volumes of participants since an optimum focus group size is postulated as being between 6 to 10 (Morgan, 1996) and 8 to 12 participants (Stewart and Shamdasani, 2015). Therefore, this approach was not considered further for the pilot study. Another considered approach involved interview which could be easily set up, but are also time consuming, and therefore appropriate for smaller studies (Robson, 2011 p286) than that intended here.

Due to the volume of responses required a questionnaire survey was considered as the most appropriate and cost effective method since this approach allowed for a large volume of participants to be involved at a relatively low cost (Coolican, 2004 p164). Furthermore, the questionnaire survey could be targeted at a wider range of participants within the community, even though they may be geographically remote. It is recognised that one disadvantage of a questionnaire is that of poor response rates. There is little agreement in what is considered acceptable although some have suggested that it should be a minimum of 60% (Mangione, 1995).

Overall, the pilot study was designed to establish whether appropriate and enough data would be derived with two questionnaires.

The pilot study was also intended to identify any potential problems with the intended methodology for study one. Two questionnaires were used which were specifically aimed at an initial small group of Police drivers. Analysis of the results of the questionnaire survey was planned so that the results could be used to determine whether the research questions would be satisfactorily addressed through a full study.

A known limitation of questionnaire studies can be socially desirable responding (SDR). SDR has been reported as where some respondents may tend to be influenced by a self-deception led from their attitudes and behaviours (Paulus and Reid, 1991). SDR was further divided into two factors known as Impression Management (IM) and Self-deception (Paulus et al. 1991). Impression management is the desire or tendency from the participant to deliberately provide answers that portray them in a positive light which is often an issue where completion and identification is in a public setting. Self-deception is where the participant provides an honest answer, but it is positively biased.

Self-deception plays an important part in driver behaviour research. Asking drivers about their own skills, possibly leads to an exaggerated belief in their own ability (Lajunen et al. 1997; Lajunen et al. 2003) with Lajunen et al. (2003) suggesting from their own research that self-reported driver behaviours were not heavily influenced by SDR and did not unduly affect the results from the Driver Behaviour Questionnaire, DBQ, (Reason, Manstead, Stradling, Baxter and Campbell, 1990).

Lajunen et al. (1997) developed a driver social desirability scale (DSDS) which considered both impression management and self-deception. Questions included “*I have never exceeded the speed limit*”, “*I have never wanted to drive very fast*”, and “*I always am sure how to act in traffic situations*”. However, they were considered a conflict to the unique occupation of the respondents and the scale was not utilised in this research.

There was also no method of preventing officers from completing the questions after discussions with colleagues also completing it which may have influenced individual responses. Due to the remote geographical completion it was not possible to control for this and it is accepted as a potential limitation. To establish if SDR was going to be of concern, each drivers background information was corroborated with their driving records, held internally on a secure database made available for the purpose of the study. Each driver's report of their driving record (including both numbers and infringement with points and collisions) was checked against the stored data, and overall no discrepancies were found. This allowed confidence in the accuracy of the data on record against their reported background responses.

### **3.4 Questionnaire Design**

Following an extensive Literature review the questionnaire was designed (Appendix 4) based on previous research in this subject area (Saunders et al. 2003; Gormley et al. 2008) which had also used the questionnaire approach. Three existing questionnaires were identified which had been academically validated and which appeared to meet the research objectives. These were the Driver Stress Inventory – DSI (Matthews, Desmond, Joyner, Carcary and Gilliland, 1996), the Driver Behaviour Inventory – DBI (Glendon, Dorn, Matthews, Gulian, Davies and Debney, 1993) and the Driver Coping Questionnaire – DCQ (Matthews et al. 1996).

Within the original source questionnaires, the DBI held 44 questions, the DSI 48 questions and the DCQ 35 questions. This was considered too large for the purpose of this investigation as the target audience were under operational time pressures and it was therefore postulated that the volume of questions would have potentially generated a poor response.

Therefore, to reduce the questionnaire size down from the combined DBI, DSI and DCQ questionnaires, questions which related to the physical process of driving were eliminated since they were not relevant to the pilot or main study. For example, several questions from the DBI were removed such as “*attempt to drive away from traffic lights in third gear*”, “*get into the wrong lane at a roundabout or an intersection*”, “*forget where you left your car in a car park*” and “*intending to drive to destination A, you wake up to find yourself heading to destination B, maybe because the latter is a more usual destination*”.

Questions which were discarded from the DSI and DCQ related to an individual’s feeling about a drive such as “*felt that I was becoming a more experienced driver*”, “*tried to gain something worthwhile from the drive*” and “*I would enjoy driving a sports car on a road with no speed limit*”. Whilst these may be useful driving related questions, it was not felt that they would add any benefit towards addressing the research questions. They were also considered non-relevant in the context of a more highly trained driver from the emergency services.

The proposed design, using a repeated measures approach, was that the first questionnaire would contain questions which related to general driving situations and for the drivers to consider their attitudes and feelings when under ordinary driving circumstances. The second questionnaire to the same participants was intended to ask the same questions although the driver was asked to consider their responses on the premise that they were driving on an emergency using the emergency warning systems.

To tailor the questionnaire to ensure it addressed the specific research area of emergency response driving 10 new questions were created. The new questions were:

*Drivers for the Fire service are highly skilled*

*Ambulance drivers are highly skilled*

*Most collisions are caused by other road users*

*Police drivers are highly skilled*

*There are too many unskilled drivers on the roads*

*Drivers are aware of how to drive appropriately when emergency vehicles come through*

*Drivers need to be educated in how to react to emergency vehicles*

*Road users are being helpful when moving out of the way of an emergency vehicle*

*Drivers seem to panic when they see an emergency vehicle with “blue lights” operating*

*Other drivers need more training in how to drive properly*

The questions were formatted to be a general statement for which a respondent could state an opinion using a Likert scale. The original DBI considers responses based on “never” through to “all of the time” on a scale of 1 to 5. The DSI and DCQ used “never” through to “very much” on a scale of 1 to 10. The original Likert scale (Likert, 1932) used five responses although there does not now appear to be much agreement in the research literature as to the optimum size for a Likert scale response (Matell and Jacoby, 1971) although Robson (2011, p303) stated that Likert scales measure someone’s attitudes. Therefore, for consistency the study followed both the Likert and DBI method of five response scoring whereby 1 is “not at all”, 2 is “rarely”, 3 is “sometimes”, 4 “most of the time” and 5 “all of the time”. All questions followed this method. It should be noted that the original DBI used “occasionally” as a possible response, but this was considered too similar to the response of “sometimes” so was amended to “rarely”, implying a greater distinction between the two possibilities.

Once the questions had been established, they were randomly placed at different locations within the questionnaire. This was to reduce the chances of participants favourably responding in subject areas (Robinson, Shaver and Wrightsman, 1991).

Section A of the questionnaire in Appendix 4, established general participant background such as age, gender, Police driver standard, and duration of licence. Section B contained questions relating to attitudes and behaviours of drivers under “non-blue” light conditions (initial survey) or “blue light” conditions (follow on survey). Two separate surveys were used since Police drivers are trained to drive differently when on an emergency response compared to ordinary non-emergency situations. In the original DBI questions were consolidated under various factors to provide a better overview of the behavioural factors which the questions in isolation may not give. The DBI factors included driving aggression, driving alertness, dislike of driving, general

driver stress, irritation when overtaken and frustration when overtaking. It was intended that the pilot study would use a simple analysis of mean responses as indicated on the Likert scale to determine driver opinion or attitude. The final questionnaire for the pilot resulted in 33 questions tested across each driving scenario of both baseline and response driving. The study was designed so that once the first questionnaire had been completed a week would be allowed before a request was sent for the second completion.

The 33 questions selected to meet the research aims have been grouped together to show which issue they were intended to address, as shown in Tables 3.1 – 3.4.

*1. Police driver's perception of their own risk and ability when compared to others.*

Q.No	Question	Source
2.	I feel confident in my ability to avoid a collision	DSI 17
4.	When driving on an unfamiliar road I can become more tense than usual	DS1 22
8.	I think I have enough experience to deal with risky situations on the road safely	DS1 4
11.	I overtake vehicles whenever possible	DBI
13.	Drivers for the Fire service are highly skilled drivers	New question
15.	I think it is worth taking risks on the road	DSI 12
20.	Ambulance drivers are highly skilled drivers	New question
21.	Most collisions are caused by other road users	New question
30.	Police drivers are highly skilled drivers	New question

**Table 3.1: Questions to address Police driver's perception of their own risk and ability**

*2. Police Drivers feelings and emotions when driving under both conditions*

<b>Q.No</b>	<b>Question</b>	<b>Source</b>
7.	I find it difficult to control my temper when driving	DSI 21
10.	I can lose my temper when another driver does something I don't like	DSI 3
14.	Driving gives me a sense of power	DBI
17.	It annoys me to drive behind a slow-moving vehicle	DSI 34
19.	When irritated I drive more aggressively	DBI
22.	I always try to stay detached or distanced from the situation	DCQ 3
24.	I become more impatient in the rush hour	DS1 31
26.	Driving makes me feel aggressive	DCQ 9
27.	It is important to let other drivers know they were at fault	DCQ 22
29.	I am patient with other road users, so they do not feel under pressure	Adapted DSI 31
31.	I have never showed other drivers what I thought of them	DCQ 8
33.	I like to try to make other drivers more aware of me by driving close behind them	DCQ 4

**Table 3.2: Questions to address Police drivers' feelings and emotions**

*3. Police Drivers attitude towards how civilians drive under ordinary conditions.*

<b>Q.No</b>	<b>Question</b>	<b>Source</b>
1.	I always make an effort to stay calm and relaxed with other road users	DCQ 14
3.	Other drivers are generally to blame for any difficulties I have on the road	DSI 19
5.	When I am in a hurry, other drivers usually get in my way	DSI 35
6.	Driving brings out the worst in people	DSI 11
9.	At times, I feel like I really dislike other drivers who cause problems for me	DSI 13
12.	I am usually patient when driving as others may not be as experienced	Adapted DSI 31
16.	There are too many unskilled drivers on the roads	New question
18.	Drivers are aware of how to drive appropriately when emergency vehicles come through	New question
23.	Drivers need to be educated in how to react to emergency vehicles	New question
25.	Road users are being helpful when moving out of the way of an emergency vehicle	New question
28.	Drivers seem to panic when they see an emergency vehicle with “blue lights” operating	New question
32.	Other drivers need more training in how to drive properly	New question

**Table 3.3: Questions to address Police Drivers attitude towards how civilians drive under ordinary conditions.**

*4. Police driver attitude and feelings as to how civilian drivers respond when they must deal with an emergency vehicle.*

Q.No	Question	Source
18.	Drivers are aware of how to drive appropriately when emergency vehicles come through	New question
23.	Drivers need to be educated in how to react to emergency vehicles	New question
25.	Road users are being helpful when moving out of the way of an emergency vehicle	New question
28.	Drivers seem to panic when they see an emergency vehicle with “blue lights” operating	New question
32.	Other drivers need more training in how to drive properly	New question

Table 3.4: Questions to address Police drivers' attitude to how civilian drivers react

### 3.5 Sampling strategy

The initial pilot questionnaires were distributed within the Police driver training unit on a specific date. This date represented the day on which Police drivers were attending a Police driver refresher course as it could then be verified that each participant would have previously completed and passed an emergency response course. The verification was conducted through accessing the internal computerised driving records. By doing so, they were considered Standard or Advanced level drivers. This conforms to Lind's (1998) definition of specific driver competency (including Basic, Standard and Advanced) as follows:

**“Basic:** Training to fulfill a patrol function within the constraints of the Highway Code.

**Standard Driving:** Extending basic training to include emergency response driving, night response driving and most importantly attitudinal training.

**Advanced Driving:** Achieving a high level of all-round driver skills, enabling pursuits and high-speed response driving, as well as a full understanding of the effects of attitude and associated stress”.

Police officers who physically attended the refresher course were asked to voluntarily complete the questionnaire, by the in house Trainers who had been briefed by the researcher. Completion of the questionnaire took place immediately prior to the commencement of their course, at a time that was allocated for completion of general paperwork. All those who were asked agreed to take part. The researcher did not meet any of the participants face to face and the sample was completely random and anonymous in terms of individual selection. Police drivers who had only completed “basic” level training (according to Lind’s definition above) were excluded from the study since they are not able to use emergency warning systems unless the vehicle is stationary, and the vehicle being used to protect a scene (College of Policing<sup>7</sup>), for example following a Road Traffic collision (RTC). These drivers are not allowed to use the vehicle to stop another vehicle or to become involved in pursuits so are therefore out of the remit of the questionnaire as respondents.

### 3.6 Data collection

Since the pilot study was intended to examine the suitability of the questionnaire, Police drivers were the only group of participants utilised since the study followed a ‘convenience sampling’ approach. In total, 15 Police drivers took part. An introductory letter, which was attached to the questionnaire, explained that there would be two questionnaires over a short period of time and that confidentiality was assured. Despite the small sample size, it was determined that the response rate ( $n=15$ ) would be enough to test the study design.

Because of professional commitments, the participants were unable to return in person to complete the follow-up questionnaire, so this was emailed to them one week later through the Force internal email system. To further ensure a good response rate a

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<sup>7</sup> College of Policing *Driver/Rider Levels – Basic Driver* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/#driver-rider-levels-and-vehicle-categories>

reminder was sent out 10 days later. This method is known to be productive in helping to increase response rates (Robson, 2011, p260).

The questionnaire was in Microsoft Word format, and Officers were therefore asked to complete it as an electronic document or print and complete it by hand. They were asked to email replies to the researcher directly. However, although 15 initial questionnaires were completed, only 4 follow-on questionnaires were returned by email despite reminder letters being sent. This produced an overall response rate of 26.7% which was thought to be low even though there seems to be little agreement as to acceptable questionnaire response rates (Nulty, 2008).

### **3.7 Participants**

All participants were volunteers and were aware they could withdraw at any point from the study. Responses were anonymised and only the Officer collar number was retained so that paired questionnaires could be tracked. 15 respondents, (all Male), participated with ages ranging from 29 to 46 years ( $\bar{x} = 37.4$  years), 14 respondents were Standard Response trained and one was Advanced Response trained. Civilian driving licences had been held between 12 and 29 years ( $\bar{x} = 19.87$  years) but as Police drivers this ranged from 3 to 13 years ( $\bar{x} = 9.27$  years).

6 drivers reported minor collisions with 2 reporting major collisions in the last three years but none of the drivers had received points or endorsements on their licence within the last 4 years. Average miles driven in a year was between 10,000 – 15,000 per annum.

### **3.8 Results**

Results from the questionnaires were entered and analysed using SPSS Statistics Software package v24. It was initially intended that the questions would be consolidated for analysis as is the structure of the DBI, DSI and DBQ. Whilst this would have been possible with the first questionnaire due to 15 participant responses, the second questionnaire only generated 4 replies. It was therefore considered to be of

little value in analysing the questions in this way as since the methodology design appeared flawed and needed to be restructured.

Full results from the pilot study can be found in Appendix 5. The original methodology was to conduct a repeated measures analysis from the initial and follow on questionnaire. However, this was identified as the study limitation and due to a low response rate, it was not possible to subsequently analyse the data in this manner. In order to establish how the respondents answered the questions a simple analysis of SPSS which considered only frequency and mean took place.

For the non-emergency driving state Police drivers generally reported that they were rarely or sometimes frustrated by other road users. The officers felt they never found it difficult to control their temper (93.3%,  $\bar{x}=1.07$ ), never (93.3%) or rarely (6.7%) drove aggressively ( $\bar{x}=1.07$ ), never (40%) or rarely (46.7%) disliked other road users ( $\bar{x}=1.80$ ) and were patient most of the time (53.3%,  $\bar{x}=4.20$ ) with other road users, indicating they were able to maintain strong coping mechanisms.

In respect of their perception of how civilians drove they reported that these drivers were rarely (40%) or only sometimes aware (33.3%) of how to drive appropriately ( $\bar{x}=2.47$ ) but collisions were rarely (26.7%) or sometimes (53.3%) caused by other road users ( $\bar{x}=2.73$ ). There was stronger opinion in that 66.7% ( $\bar{x}=2.80$ ) felt there were too many unskilled drivers on the road sometimes, and 13.3% agreed this was the case most of the time, 46.7% ( $\bar{x}=4.13$ ) felt civilian drivers definitely needed to be educated in how to drive appropriately when reacting to an EV, but believed that the civilian drivers overall were being helpful in their actions with 73.3% ( $\bar{x}=4.07$ ) reporting this was the case definitely or most of the time.

The follow on questionnaire was also analysed for frequency and mean and can be found in Appendix 5. 75% of the Police respondents felt civilian drivers sometimes got in their way ( $\bar{x}=2.75$ ) with 50% reporting that they never became annoyed with a slow moving vehicle ( $\bar{x}=2.0$ ) whilst on response, and 75% never feeling impatient in the rush hour ( $\bar{x}=1.50$ ). The Police drivers reported feeling calm “most of the time” (50%) or “definitely” (50%) ( $\bar{x}=4.50$ ) and 75% reported they never found it difficult to control their temper ( $\bar{x}=1.25$ ) which again indicated that coping mechanisms appeared to be

in place. When asked to consider how civilians drive there was no clear response about whether they were deemed unskilled as all 4 respondents gave 4 different replies. Of the respondents 50% believed civilians only “sometimes” drive appropriately ( $\bar{x}=3.0$ ) and 50% also thought that they caused collisions ( $\bar{x}=3.0$ ). In respect of whether civilian drivers needed educating 50% felt that this was “sometimes” the case ( $\bar{x}=3.25$ ), 75% believed civilian drivers panic ( $\bar{x}=2.75$ ) but 50% also felt that they were being helpful in moving out of the way ( $\bar{x}=4.50$ ).

Under ordinary driving conditions, the Police officers were very confident in their own ability to avoid a collision (73.3% “most of the time”, 26.7% “definitely”,  $\bar{x}=4.27$ ), and 93.3% would “never” try to make drivers more aware of them by driving close ( $\bar{x}=1.07$ ). Under emergency driving conditions the results were much higher with 25% reporting “most of the time” and 75% “definitely” when considering their ability to avoid a collision ( $\bar{x}=4.75$ ) which may illustrate a higher level of confidence when operating under these conditions. The Police drivers were less certain in the emergency state regarding letting others know they were behind by driving close as 50% stated they would “never” do so and 50% stated “rarely” ( $\bar{x}=1.50$ ). When asked to consider whether Fire Service drivers were skilled the Police drivers rated them higher under emergency conditions than non-emergency conditions ( $\bar{x}=3.80$ ). For Ambulance driver skill the Police drivers rated the non-emergency driving ( $\bar{x}=3.80$ ) and emergency driving ( $\bar{x}=4.00$ ) as the same as had been reported for the Fire Service. However, when asked about their own driving skill level, they reported a lower mean for non-emergency driving ( $\bar{x}=3.67$ ) and only marginally higher for emergency driving ( $\bar{x}=3.75$ ), illustrating that they considered their driving skill to be inferior to other services.

### 3.9 Discussion and Conclusion

The main purpose of the pilot study was to ensure that the methodology design was feasible, and in this case, it proved not to be. The two questionnaire design proved to be impractical for the respondents since it resulted in a low response rate (only 4 of the 15 follow-on questionnaires were returned) meaning it was difficult to compare results between the two conditions.

It was also difficult to draw any comparisons or conclusions between the results for the two questionnaires due to the limited response of just 4 participants and as such the results for the follow on questionnaire could only be analysed in a limited context. It is important to highlight that whilst some results were achieved, they should not be taken as indicative of findings expected from the main study due to the small sample size. It was therefore felt that issuing the questionnaires to further participants to increase the response rate, as part of the pilot study, would not be beneficial as the main study design problem had been largely identified. It was deemed necessary to rewrite the questions in such a way that a new single stage questionnaire could be issued. Specific issues identified related to the wording of the individual questions. For example, the initial questionnaire asked, "*Driving makes me feel more aggressive*" which originated from the DCQ and was intended to force respondents to consider this when applied to general driving, not emergency response driving. The follow on questionnaire then required drivers to consider the emergency response situations and the comparative question was "*Driving makes me feel aggressive when I am responding to an urgent call*". Therefore, for the revised single stage format, it was postulated that an amended example question could be "*Driving makes me feel more aggressive when I am responding to an emergency call*" as this gives participants the opportunity to consider an alternative state as a comparison before answering.

Consolidated questions were not created in the pilot as it was felt that it would not add value due to the design issues being identified. Overall, it was recognised that both the questions and the questionnaire structure should be improved since the results of the pilot study could not offer any indications as to trends.

From the pilot study some limited results could be analysed. Preliminary analysis showed that the Police drivers do not think civilian drivers are being deliberately obstructive. They believed that the civilian drivers are mostly being helpful in easing their passage through. However, the respondents expressed the opinion that the civilian drivers sometimes panic in their efforts to assist the EV's passage, but this is not entirely in line with previous research. Gormley et al. (2008) reported that 91% of Firefighters in their study believed civilians panicked. The pilot study questioned Police drivers and the difference may be due to the small data set providing a poor representation or alternatively due to cultural differences between the services, the

differing role they provide or even the type and size of vehicles. The pilot study found that the Police respondents felt that civilian drivers were “rarely” aware of how to drive appropriately when interacting with an EV which was in line with Dorn et al. (2003) who found that Police drivers considered civilian drivers to be unpredictable. The respondents also believed that civilians “mostly” needed to be educated in how to drive safely around emergency vehicles.

Alicke, Klotz, Breitenbecher, Yurak and Vredenburg (1995) reported on the “better-than-average effect” where individuals rated themselves above others. Waylen et al. (2004) found that even those considered expert drivers rated their ability above their peers, as drivers automatically found the positives in their own behaviours and negatives in others. The pilot study asked Police drivers to rate their driving ability and that of their counterparts within the Ambulance and Fire service. The results showed Police drivers did not rate themselves higher than their peers. Due to the small number of respondents and the fact it was not possible to interview the 15 participants who did reply, this lower self-rating was replicated in the main study to evaluate possible reasons. The reasons for this answer may include Police drivers believing that they are not as skilled due to the number of collisions that occur in the Police Force, the drivers themselves being anxious based on personality, training mitigating the risks of overconfidence or (most likely) the small sample being a poor representation of the wider view.

Therefore, as result of the pilot study, the next chapter used a newly created single stage questionnaire to address RQ1 which could not be addressed in the pilot study. The new questionnaire allowed analysis of the questions using a composite format.

## Chapter 4: Do Emergency drivers feel frustration towards civilian drivers whilst responding due to their own higher driver skills? A quantitative study (Study One)

### 4.1 Overview

This study was designed to investigate the emotions and perceptions of an emergency response driver towards that of the civilian driving population. The literature review considered the effect a slow moving driver may have on feelings of frustration for an emergency driver (Malta et al. 2011; Trick et al. 2012; Chapman et al. 2013). Depending on personality (Mitchell et al. 1990; Lajunen et al. 1998) and coping mechanisms (Salters - Pedneault et al. 2010) the outcome will vary, with poor coping leading to subjective states such as anger, anxiety or fatigue alongside poor driving performance (Matthews, 2002). The effect of frustration may lead to momentary lapses of attention or an increase in near misses (Neale et al. 2005). Near misses are considered further in later chapters through analysis of real world Police driving footage.

This frustration can also be generated through a perception of the civilian driver's poor reaction (Malta et al. 2011), a belief of one's own highly skilled driving in comparison (Gormley et al. 2008) or through the attempt to achieve a goal (Lee, 2010; Oz et al. 2010) such as arriving at the emergency quickly. Several researchers reported that a civilian driver may act in an adverse manner (Dorn et al. 2003; Shultz et al. 2009), but these were unsubstantiated within the literature. It was also suggested that civilian drivers were to blame for the resulting collisions (Saunders et al. 1994; Clarke et al. 2009). Therefore, this study considered several key points using a questionnaire issued to UK emergency drivers from the Police, Fire and Ambulance services to gauge their opinions. No study could be identified which considered the views of all three emergency services in which to then provide direct comparisons. One published paper asked for the views from just 43 Firefighters in the Republic of Ireland using a similar questionnaire methodology (Gormley et al. 2008). The questions in this chapter covered self-reported levels of frustration or stress, perceived panic or adverse driving reactions by civilians, whether civilian drivers are believed to be the cause of

emergency driver stress, coping strategies and a self-evaluation of their own driving skills.

The purpose of the questionnaire was to provide evidence to use in conjunction with collision data and ANPR footage gathered from a Police Force.

## 4.2 Research questions

The questionnaire has been designed in support of the following research questions.

**RQ1:** Do the Police, Fire and Ambulance service emergency drivers report similar levels of frustration, and have the same perceptions of civilian driving, whilst they are on an emergency response?

**RQ2:** Do the Police, Fire and Ambulance drivers have the same belief that drivers should discuss feelings after an emotional call?

**RQ3:** Do the Police, Fire and Ambulance Service emergency drivers each rate their own driving skills as more highly skilled than that of their colleagues in the corresponding emergency service?

Following the literature review this study reviewed the opinions surrounding stress and frustration, perception of a civilians driving, coping, the perception of their own emergency driving and a comparison of their own driving skill perception against that of their driving peers from other emergency services.

## 4.3 Methodology

To capture a large volume of data which considered individual opinions, feelings, perceptions or emotions a questionnaire was designed following a pilot study. This research method is one of the most common methods of gathering data (Coolican, 2004 p169). Information was given to the potential respondents, by way of a covering letter about the purpose of the questionnaire, although this was kept to a minimum to reduce any possible experimenter bias. The letter highlighted that the organisation

they worked for fully supported the research and that all responses were completely anonymous. To reduce the chance of the respondent attempting to answer in a certain way the questions were randomly distributed so that they did not display a trend in subject matter and be prone to responding bias.

It is recognised that the emergency service drivers each perform a different role, within their sector, albeit they must all respond quickly to an emergency. The levels of training will vary according to need but within the legislative constraints of the High Speed Driver Training guidance (HSDT, 2008; DTAG, 2014). They will operate within their own localities but equally may be required to drive outside of the Trust, Service or Force area if following a suspect vehicle or to aid another unit. Within the Police there are three levels of driving standard (Lind, 1998) being Basic, Standard and Advanced as discussed in Chapter 3. It is accepted that even with drivers who are working for the same Force but at different grades it may influence any responses. Due to the drivers often operating from different vehicles, for all emergency service types, it was not possible to independently establish work related mileage, and as such control for risk exposure. Participants were asked to estimate their annual mileage, but it is not possible for this to be accurately verified due to the self-report nature, and the time that has elapsed, both of which make validity unreliable (af Wåhlberg, 2011; af Wåhlberg and Dorn, 2015). The lack of training records and verified mileage is acknowledged as a weakness which was not possible to overcome in this study.

#### **4.4 Questionnaire design**

The pilot study identified a design weakness which had the effect of reducing participant response rates using an original format of two questionnaires (an initial and then follow on). The initial questionnaire asked drivers to consider themselves under ordinary driving conditions (non-emergency). The follow on questionnaire asked identical questions but asked respondents to now consider their response as if they were in an emergency driving state. Due to a desire to avoid poor response rates in the main study, the methodology as a result, was reviewed and rewritten so that a single questionnaire could be issued. It was anticipated that this single questionnaire should have the effect of increasing response numbers due to the reduced time required from respondents.

The original pilot study questionnaires were developed by extracting questions from three existing and validated research questionnaires. The questions were selected, and in some cases slightly modified, from the Driver Behaviour Inventory - DBI, (Glendon et al. 1993), Driver Stress Inventory - DSI, (Matthews et al. 1996), and the Driver Coping Questionnaire - DCQ (Matthews et al. 1996). The research conducted in this study involved a specific group of drivers, so it was decided to use a combination of questions from the DBI, DSI and DCQ considered relevant to the research aim.

To address the problem identified in the pilot study a review of the initial and follow on questionnaires took place so that the questions could be combined into one single version, which still addressed the research aims. The results from the pilot study can be found in Appendix 5. All questions used in the previous version were considered in turn and as a result some were removed or reworded. The replaced questions were considered to more accurately reflect the research aim and the previous questions would not have added further value.

<b>Q No.</b>	<b>Questions removed from the initial questionnaire</b>	<b>Source</b>
7.	I find it difficult to control my temper when driving	DSI 21
17.	It annoys me to drive behind a slow moving vehicle	DSI 34
31.	I have never showed other drivers what I thought of them	DCQ 8
32.	Other drivers need more training in how to drive properly	New Question
33.	I like to try to make other drivers more aware of me by driving close behind them	DCQ 4

**Table 4.1: Questions removed from the initial questionnaire**

Additional questions were taken from the established DSI and DCQ, alongside newly created questions by the researcher, which were considered more relevant to the research aims of the main study.

<b>Q No.</b>	<b>Questions added to the main study questionnaire</b>	<b>Source</b>
15.	Following a difficult or traumatic call I would discuss my feelings with colleagues afterwards	New Question
16.	I become more stressed when driving behind a slow moving vehicle if I am on my way to an emergency	DSI 34
26.	Following a difficult or traumatic call emergency service drivers should discuss their feelings with colleagues	New Question
30.	Other drivers need more training in how to drive appropriately around emergency vehicles ( <i>reworded from Q.32 above</i> )	New question
31.	Emergency driving is a stressful part of my job	New Question
33.	Under ordinary driving conditions when irritated by another road user I drive more aggressively	DCQ 9
34.	When responding I become more impatient in the rush hour	DSI 31
35.	Under ordinary driving conditions I become more stressed when driving behind a slow moving vehicle	DSI 34

**Table 4.2: Questions added to the questionnaire***Composite questions*

Several questions were designed to explore the same feelings or opinion so were grouped and a composite score calculated representing the mean response across the questions. The originating source for each question is noted in the tables below with the remainder developed specifically for this study.

Questions marked \* were reversed when the composite score was created. This was because the questions were in the opposite direction (positive or negative) of the remaining questions within the group.

The groupings have been developed in Tables 4.3 to 4.7.

### Stress and frustration (emergency response conditions)

Q No.	Question	Source
3.	When responding to an emergency, other drivers are generally to blame for any difficulties I have on the road	DSI 19
4.	When driving on an unfamiliar road with “blue lights” I can become more tense than usual	DSI 22
5.	When I am in a hurry on the way to an emergency, other drivers usually get in my way	DSI 35
8.	At times, I feel I really dislike other drivers who cause problems for me when I am responding	DSI 13
9.	When responding with lights and sirens I can lose my temper when another driver does something I don’t like	DSI 3
16.	I become more stressed when driving behind a slow-moving vehicle if I am on my way to an emergency	DSI 34
25.	Driving makes me feel more aggressive when I am responding to an emergency call	DSI 40
31.	Emergency driving is a stressful part of my job	New question
34.	When responding I become more impatient in the rush hour	DSI 31

Table 4.3: Question grouping for stress and frustration (emergency response)

**Stress and frustration felt, whilst interacting with other road users (ordinary conditions)**

<b>Q No</b>	<b>Question</b>	<b>Source</b>
6.	Driving brings out the worst in people	DSI 11
23.	Under ordinary driving conditions I become more impatient in the rush hour	DSI 31
35.	Under ordinary driving conditions I become more stressed when driving behind a slow-moving vehicle	DSI 34

**Table 4.4: Question grouping for stress and frustration (ordinary driving conditions)**

**Perceptions of civilian driving skills**

<b>Q No</b>	<b>Question</b>	<b>Source</b>
17.*	Civilians are aware of how to drive appropriately when emergency vehicles come through	New question
20.	Most collisions which involve an emergency response vehicle are caused by other road users	New question
22.	Drivers need to be educated in how to react to emergency vehicles	New question
24.*	Road Users are being helpful to me when moving out of the way of the emergency vehicle	New question
27.	Drivers seem to panic when they see an emergency vehicle with "blue lights" operating	New question
30.	Other drivers need more training in how to drive appropriately around emergency vehicles	New question
32.	There are too many unskilled drivers on the road	New question

**Table 4.5: Question grouping for a perception of civilian driving skill**

## Stress Coping

<b>Q No</b>	<b>Question</b>	<b>Source</b>
1.	I always make an effort to stay calm and relaxed around other road users whilst responding	DSI 14
11.	I am usually patient with others when on emergency response as others may not be as experienced	Adapted DS1 31
18.*	Whilst responding, when irritated by another road user I drive more aggressively	DCQ 9
21.	I always try to stay detached or distanced from the situation whilst I am responding	DCQ 3
28.	When on response I am patient with other road users, so they do not feel under pressure	Adapted DS1 31
33.*	Under ordinary driving conditions when irritated by another road user I drive more aggressively	DCQ 9
36.*	It is important to let other drivers know they were at fault if they impede my emergency progress	DCQ 22

Table 4.6: Question grouping for stress coping

## Perception of a driver's own ability

<b>Q No</b>	<b>Question</b>	<b>Source</b>
2.	I feel confident in my ability to avoid a collision whilst responding	DBI
7.	When on "blue lights" I think I have enough experience and training to deal with risky situations on the road safely	DSI 4
10.*	On response I overtake vehicles whenever possible	DBI
13.*	Whilst operating with "blue lights" and sirens driving gives me a sense of power	DBI
14.*	I think it is worth taking risks when on response to get to the emergency quicker	DSI 12

Table 4.7: Question grouping for perception of a driver's own ability

\* These questions were later reversed for inclusion within a composite score

### *Comparative questions*

Five new questions were created, designed to contribute to addressing the research questions. They were designed as standalone questions but were not deemed suitable for a composite format.

### **Individual Stress Management**

**RQ2:** Do the Police Fire and Ambulance drivers have the same belief that drivers should discuss feelings after an emotional call?

<b>Q No</b>	<b>Question</b>	<b>Source</b>
15.	Following a difficult or traumatic call I would discuss my feelings with colleagues afterwards	New question

**Table 4.8: Question of whether a driver would discuss their feelings**

<b>Q No</b>	<b>Question</b>	<b>Source</b>
26.	Following a difficult or traumatic call emergency services drivers should discuss their feelings with colleagues	New question

**Table 4.9: Question of whether a driver should discuss their feelings**

**RQ3:** Do the Police, Fire and Ambulance Service emergency drivers each rate their own driving skills as more highly skilled than that of their colleagues in the corresponding emergency service?

### Perception of emergency driver skill level

<b>Q No</b>	<b>Question</b>	<b>Source</b>
12.	Drivers for the Fire service are highly skilled	New Question

Table 4.10: Question for perception of Fire Service driving skill

<b>Q No</b>	<b>Question</b>	<b>Source</b>
19.	Ambulance drivers are highly skilled	New Question

Table 4.11: Question for perception of Ambulance service driving skill

<b>Q No</b>	<b>Question</b>	<b>Source</b>
29.	Police drivers are highly skilled	New Question

Table 4.12: Question for perception of Police driving skill

### 4.5 Data collection / sampling strategy

Two of the key elements of the study were to establish whether the different emergency services perceive civilian driving in the same way and their perception of the other services driving when compared to their own. Following discussions several services agreed to participate in the study, these being South Wales Police (SWP), West Midlands Fire and Rescue Service (WMFS), Oxfordshire Fire and Rescue Service (OFS) and North West Ambulance Service (NWAS).

To select possible participants from the Police the Researcher had access to computerised driver training records. A search was carried out to identify all drivers

currently on the internal Police records system who had previously received Emergency Response Driver training to either Standard or Advanced level. The questionnaire was emailed directly to them using the Force internal email system. All potential respondents were free to choose if they wished to participate and responses were anonymised. To increase the initial response rate a reminder was sent out approximately one week later which generated a further response. Approximately 1000 emails were originally sent with 160 Police responses finally being returned either by email or through the internal mail system. This produced an overall response rate of 16%.

As the Fire and Ambulance services were collecting on the researchers' behalf it was more difficult to know how many questionnaires were originally sent or to whom. Each organisation was asked to distribute to all their current emergency responses drivers. WMFS and OFS sent questionnaires to all Station managers who were then asked to distribute this among their driving personnel. It was estimated, by the combined Fire Services, that 500 emails were sent out. WMFS and OFS initially returned 93 questionnaires by email. A reminder to all drivers was sent by the Training manager which generated a further 20 responses. The total response was therefore 113 (22.6%).

NWAS asked all emergency response drivers attending a weekly driver training course alongside emergency warning system user managers to complete the questionnaire. This method generated a 100% response rate as it was a direct target.

	<b>Frequency</b>	<b>Overall %</b>
Police	160	43.2
Fire	113	30.5
Ambulance	97	26.2
Total	370	100

**Table 4.13: Questionnaire response by Occupation**

## 4.6 Participants

The demographics of the respondents from each participating service, totalling 370 in Table 4.13, are described below in Table's 4.14 – 4.17, which were gathered for background and information purposes.

	Police (n=160)	Fire (n=113)	Ambulance (n=97)
Female (%)	17.6	4.6	64.4
Age in years ( $\bar{x}$ )	43.4	41.4	40.1
Service in years( $\bar{x}$ )	16.7	12.1	11.7
Points ( $\bar{x}$ )	0.11	0.12	0.04

Table 4.14: Participant demographics

Annual Mileage	Police (n=160)	Fire (n=113)	Ambulance (n=97)
Less than 5,000	2	1.3%	3
5,000-10,000	20	12.5%	35
10,000-15,000	35	21.9%	27
15,000-20,000	48	30%	30
Over 20,000	55	34.4%	18
		2.7%	2
		31%	15
		23.9%	18
		26.5%	19
		15.9%	43
			44.3%

Table 4.15: Proportion of mileage reported across occupation

The Police, Fire and Ambulance service self-reported minor collisions (in the last 3 years where value was less than £500 regardless of blame – Matthews et al. 1996) can be seen in Table 4.16. For the Police and Fire Service this ranged between 0 and 2 collisions (Police  $\bar{x} = 0.25$ , Fire  $\bar{x} = 0.24$ ). However, the Ambulance service reported a higher mean ( $\bar{x} = 0.49$ ) which was due in part to one respondent who had declared several driving issues. A 60-year-old respondent disclosed 12 minor collisions and 3 major collisions within the last 3 years alongside 3 licence endorsement points for use of a mobile phone.

No. of minor collisions	Police (n=160)		Fire (n=113)		Ambulance (n=97)	
0	123	76.9%	93	82.3%	66	68%
1	34	21.3%	13	11.5%	25	25.8%
2	3	1.9%	7	6.2%	4	4.1%
3	0	0	0	0	1	1%
12	0	0	0	0	1	1%

**Table 4.16: Proportion of minor collisions reported across occupation**

For major collisions (Table 4.17), where value was greater than £500 (Matthews et al. 1996), the mean for the Police was ( $\bar{x} = 0.11$ ), the Fire Service ( $\bar{x} = 0.11$ ) and the Ambulance service ( $\bar{x} = 0.14$ ). A visual inspection of the cases in Table 4.17 showed that for major collisions totalling 0, 1 or 2 in frequency there was little percentage difference across the services.

No. of major collisions	Police (n=160)		Fire (n=113)		Ambulance (n=97)	
0	145	90.6%	102	90.3%	86	88.7%
1	13	8.1%	9	8%	9	9.3%
2	2	1.3%	2	1.8%	1	1%
3	0	0	0	0	1	1%

**Table 4.17: Proportion of major collisions reported across occupation**

In summary whilst the Police and Fire service reported similar results the Ambulance service had the highest female ratio, the youngest average age, shortest length of service driving professionally, highest average number of both minor and major collisions, the fewest average points and the highest average miles per annum.

## 4.7 Data processing and Statistical Testing

The final 370 questionnaire responses were entered into the IBM statistical software package SPSS v24. The questionnaire consisted of 36 main questions which utilised a Likert type scale requiring a response of “not at all”, “rarely”, “sometimes”, “most of the time” or “definitely” and which was subsequently ranked from 1 to 5 for analysis

purposes. This type of data is recognised as ordinal data and can be analysed using non-parametric tests.

As explained in section 4.4, questions were grouped in order to form composite scores. Questions within the group varied according to their direction, for example, sometimes a ranking of 1 could indicate ‘least stressed’ and sometimes it could indicate ‘most stressed’. In order to generate the composite, score the responses should be unilateral and therefore some responses were reversed in order to correct for the opposing direction. Cronbach’s Alpha (Robinson et al. 1991) was used to test for the internal consistency of each group of questions forming a composite score. This measures the strength of the relationship between each possible pair of questions forming the composite score to indicate how well the combined score represents the ‘object’ such as ‘stress’ being measured.

A Null Hypothesis Statistical Testing (NHST) has been taken for all throughout where in all cases the Null Hypothesis ‘H<sub>0</sub>: No difference between groups’ is rejected in favour of the alternative ‘H<sub>A</sub>: Differences between groups exist’ when a significant result is returned.

Kruskal Wallis ( $\chi^2$ ) has been used to test for significant differences between the responses from each of the 3 services. This is appropriate for ordinal data where there are 3 or more independent groups (Vargha and Delaney, 1998) to be tested with the comparison being made between the mean ranks for each group. Although the composite score data could be considered scalar data, non-composite data is ordinal and therefore all differences have been assessed using Kruskal-Wallis for consistency in the testing. When Kruskal-Wallis returns a significant result, post-hoc tests have been undertaken. This test, known as the Mann-Whitney U test (McKnight and Najab, 2010) identifies the significant pairwise comparisons between two groups on an ordinal variable. To check for statistical significance a Bonferroni correction (Napierala, 2012) was made according to the number of pairwise comparisons within the post-hoc testing (where p must be equal to α divided by the number of tests).

Comparisons between the two independent groups ‘Advanced’ and ‘Standard’ grade Police drivers have been tested using the Mann-Whitney U test.

Where the analysis has aimed to identify a relationship between two questions, Spearman's rho has been applied. In this case the null hypothesis is 'H0: No correlation' with the alternative being 'HA: There is a correlation'

All statistical testing has been carried out at the 95% level with  $\alpha=0.05$ , therefore results are considered statistically significant and unlikely to be due to sampling error, when the significance of the test ( $p$ ) is less than 0.05 or less than 0.017 when the Bonferroni adjustment is applied.

## 4.8 Results

### 4.8.1 Stress and frustration felt, whilst interacting with other road users (“Blue light” conditions)

A total of twelve questions were asked which attempted to establish whether an emergency driver felt more or less stressed when driving under both ordinary conditions (3 questions) and “blue light” conditions (9 questions) whilst interacting with other road users. It was hypothesised that there would be no difference in the feelings of stress or frustration, caused by other road users, between occupations when responding using the emergency warning systems.

Nine questions (3, 4, 5, 8, 9, 16, 25, 31, and 34) which addressed the emergency response condition were extracted to create a composite score within SPSS labelled “stress on response”. Cronbach’s Alpha was 0.744 (Robinson et al. 1991) indicating good internal consistency across the questions. The full data tables can be found in Appendix 7.

There was a statistically significant difference in the composite score across the 3 services ( $\chi^2 (2) = 21.676$ ,  $p<0.001$ ) with mean ranks for the Police 161.94, Fire 184.23, and the Ambulance 225.84. Post hoc tests showed significant differences between the Police and Ambulance ( $U=5070.50$ ,  $Z=-4.667$ ,  $p <0.001$ ), and the Fire and Ambulance ( $U=4257.00$ ,  $Z= -2.793$ ,  $p=0.005$ ).

The results have shown that drivers for the Ambulance service felt the highest levels of stress whilst on response, through dealing with other motorists, followed by the Fire service and then Police self-reporting the least stress and frustration although the difference in the sample between the Police and the Fire is not statistically significant.

#### 4.8.1.i

*Stress on response: Comparison between Advanced and Standard Grade Police drivers*

Driver grades were not available for the Fire and Ambulance services so a comparison for Advanced and Standard response Police drivers only was conducted. The driving grade related to those who had participated in the questionnaire completion for this study. Gandolfi et al. (2003) reported that Advanced Police drivers were less likely to acknowledge mood effects when compared to Standard Grade Police drivers. There was a significant difference in the composite score of how stressed drivers reported feeling whilst on response ( $U=1945.00$ ,  $Z=-2.972$ ,  $p=0.003$ ) with Advanced Police drivers reporting lower levels (mean rank = 64.40) than Standard Response drivers (mean rank = 87.82).

#### 4.8.2 Stress and frustration felt, whilst interacting with other road users (ordinary conditions)

Three questions (6, 23 and 35) were asked, which attempted to establish whether an emergency driver felt more, or less stressed and frustrated in ordinary driving conditions. This emotional state was previously considered under emergency driving conditions in 4.8.1. “Ordinary” conditions were considered as when the personnel were not responding to any emergency call and were engaging in usual driving practices, as were all other road users. This was to investigate if the condition itself increased the stress and ultimately affected the emotion felt. A composite was created within SPSS and labelled as “stress non-emergency”. To ensure the composite score had reliability the Cronbach Alpha test was applied for internal consistency and measured 0.600. This is considered a moderate level (Robinson, Shaver and Wrightsman, 1991) and acceptable.

It is accepted that for this question a lower number of questions were created into a composite score, in relation to other question groupings used.

There was a statistically significant difference between each occupation and the levels of self-reported stress under ordinary driving conditions ( $\chi^2 (2) = 28.449$ ,  $p<0.001$ ) and the mean ranks for the Police were 152.15, Fire 214.79 and Ambulance 206.39.

Post hoc tests established statistical significance between the pairings of the Police and Fire service ( $U=5940.00$ ,  $Z=-4.891$ ,  $p<0.001$ ) and the Police and Ambulance service ( $U=5524.00$ ,  $Z=-3.922$ ,  $p<0.001$ ).

The composite score showed that operating under ordinary, non-emergency driving conditions the Fire service reported the highest feelings of stress and frustration when delayed by other road users. This was followed by the Ambulance service which reversed the results from the “blue light” condition. The Police reported feeling the least stressed under this condition for ordinary driving, as was also the case for the blue light condition.

In summary the Police appear to self-report the lowest levels of stress when driving under ordinary conditions. It was not possible to interview the respondents, so it is unclear as to why the Police reported feeling the least stressed, but this was reviewed later in this chapter by considering the responses to the other questions.

#### 4.8.2.i

##### *Stress under ordinary driving conditions: Comparison between Advanced and Standard Grade Police drivers*

An analysis of the levels of reported stress when under ordinary conditions found that again Advanced drivers were less stressed than those who were of a Standard Response grade. This is the same result as under the emergency conditions (paragraph 4.8.1) and in line with previous research (Gandolfi et al. 2003). The post-hoc tests were statistically significant ( $U=1972.500$ ,  $Z=-2.911$ ,  $p=0.004$ ) between the pairings of Advanced drivers (mean ranks = 64.95) and Standard Response drivers (mean ranks = 87.57).

#### 4.8.2.ii

Three questions were originally combined to create the composite score. To provide a deeper insight into the responses the questions were then considered on an individual basis but only where they were statistically significant. As such Question 6 was not considered further due to it not being statistically significant.

*Question 23 - “Under ordinary conditions I become more stressed when driving in the rush hour”*

Question 23 asked drivers if they became more stressed in the rush hour when driving in ordinary, non-emergency conditions. The results were statistically significant ( $\chi^2(2) = 21.380$ ,  $p<0.001$ ) with mean ranks for the Police 157.97, Fire 210.62, and the Ambulance 201.66. Post hoc tests showed significant differences between the Police and Fire ( $U=6449.50$ ,  $Z=-4.301$ ,  $p<0.001$ ), and the Police and Ambulance ( $U=5945.00$ ,  $Z=-3.377$ ,  $p<0.001$ ).

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	54.4	27.5	13.8	3.1	1.3
<b>Fire (n=113)</b>	29.2	38.1	17.7	8.8	6.2
<b>Ambulance (n=97)</b>	36.1	28.9	22.7	9.3	3.1

**Table 4.18: Under ordinary conditions I become more stressed when driving in the rush hour (question 23).**

A closer review of the frequencies for question 23 above showed little difference between the Fire and Ambulance respondents and this was confirmed in the non-statistically significant post hoc pairing. 3.1% more Fire service participants responded they would “definitely” become stressed under ordinary conditions in the rush hour, when compared to those from the Ambulance Service and 4.5% more than the Police for the same response. The Police reported lower feelings of stress during the rush hour and 14.6% fewer Police respondents reported this state for the responses of “not at all” or “rarely” compared to the Fire Service.

#### 4.8.2.iii

*Question 35 – “Under ordinary driving conditions I become more stressed when driving behind a slow-moving vehicle”*

It was reported in the literature review that drivers may feel more frustration when driving behind a slow moving vehicle. The same question was asked for both emergency (question 16) and non-emergency states (Question 33). The results were statistically significant for ordinary driving conditions ( $\chi^2 (2) = 33.461$ ,  $p<0.001$ ) with mean ranks for the Police 152.00, Fire 216.50, and the Ambulance 204.65. Post hoc tests showed statistically significant differences between the Police and Fire pairings  $U=5876.00$ ,  $Z=-5.399$ ,  $p<0.001$ ), and the Police and Ambulance pairing ( $U=5563.50$ ,  $Z=-4.209$ ,  $p<0.001$ ). The difference in the sample between the Fire and Ambulance was not statistically significant.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	61.3	30.6	6.9	1.3	0
<b>Fire (n=113)</b>	29.2	49.6	12.4	7.1	1.8
<b>Ambulance (n=97)</b>	36.1	43.3	13.4	6.2	1.0

**Table 4.19:**

**Under ordinary driving conditions I become more stressed when driving behind a slow-moving vehicle (question 35)**

From Table 4.19, 61.3% of the Police reported not being stressed at all behind a slow moving vehicle, which was twice the proportion of the Fire Service. There was little statistical variance between the Fire and Ambulance responses, and this was identified by the non-significant mean ranks pairing for the composite score (Appendix 8).

#### **4.8.3 Perception of civilian driver reaction when interacting with the emergency vehicle.**

A composite score was created which encompassed the responses to seven individual questions (17, 20, 22, 24, 27, 30 and 32) from the modified questionnaire. This was to give an overview of how the emergency drivers feel about civilian driving. The measure for internal consistency, as determined by Cronbach alpha, was 0.683 deemed moderate.

Two questions, 17 and 24, were reversed for inclusion in a composite score so that all questions were in the same response direction. The questions considered a positive outlook to how a civilian driver acts (*"Civilian drivers are aware of how to drive appropriately when emergency vehicles come through"*, *"Road Users are being helpful to me when moving out of the way of the emergency vehicle"*) whereby all other questions considered the negative actions.

There was a statistically significant difference in the composite score across the Police, Fire and Ambulance services ( $\chi^2 (2) = 18.423$ ,  $p<0.001$ ) and the perception of how other drivers react. The mean ranks showed the Police have the lowest negative perception of how civilian drivers react compared to the Ambulance which were the most negative overall. (Police mean ranks 159.07, Fire 198.47 and the Ambulance service 213.97).

Post hoc results identified that the pairwise differences between the Police and Fire ( $U=7077.50$ ,  $Z=-3.064$ ,  $p=0.002$ ), and Police and Ambulance ( $U=5494.00$ ,  $Z=-3.934$ ,  $p<0.001$ ) were statistically significant, and results are shown in Appendix 9. The Fire and Ambulance pairing was not statistically significant.

It is possible to say that the Police report the most positivity overall towards civilian drivers regarding how they interact with other road users. When considering the composite stress score earlier the Police also reported lower levels of stress which would be expected.

#### 4.8.3.i

##### *Question 20 – “Collisions are caused by other road users”*

Question 20 which formed part of the composite score, respondents were asked to consider the statement that “collisions are caused by other road users”. This was considered a relevant question due to the thesis considering collision data from the Police in a later chapter and may add further insight into why collisions occurred. There was no statistically significant difference across the three services ( $\chi^2 (2) = 2.234$ ,  $p=0.327$ ) with Police mean ranks 180.92, Fire Service 181.78, and the Ambulance service 197.39.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	2.5	22.5	64.4	10.0	0.6
<b>Fire (n=113)</b>	3.5	23.0	60.2	12.4	0.9
<b>Ambulance (n=97)</b>	0	18.6	67.0	14.4	0

**Table 4.20: Frequency for “Collisions are caused by other road users” (question 20)**

The frequency analysis in Table 4.20 showed little difference in the responses from the Police and Fire participants. The Ambulance drivers generally had a stronger belief that collisions were caused by other road users although not a statistically significant result overall.

#### 4.8.3.ii

##### *Question 24 – “Civilian drivers are being helpful in moving out of the way”*

The composite score was created to look at how civilian drivers were perceived to behave as an overview, with question 24 forming part of the composite score, asking the respondents specifically to consider if they thought civilian drivers were being helpful. The single question 24 would aid in helping to appraise footage gathered from real world driving, from the Police, looking at whether civilian drivers know how to react and if they were panicking. As with question 20 the results were not significant ( $\chi^2(2)$

= 1.187, p=0.552) with mean ranks for the Police 191.61, Fire 178.52 and Ambulance 183.55 so it is likely results occurred by chance.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	0.6	6.3	15.6	41.3	36.3
<b>Fire (n=113)</b>	0	5.3	15.0	54.9	24.8
<b>Ambulance (n=97)</b>	0	4.1	23.7	38.1	34.0

**Table 4.21: Frequency for “Civilian drivers are being helpful in moving out of the way” (question 24)**

An analysis of frequency in Table 4.21 showed that the Ambulance drivers thought civilian drivers were being the least helpful overall when compared to the responses from the other service participants.

#### 4.8.3.iii

*Question 27 - Drivers seem to panic when they see an emergency vehicle with “blue lights” operating*

The literature review considered how different research papers have mentioned how civilian drivers may react and have used a variety of words to describe the driver actions but with little substantiated evidence. This question, in combination with other gathered evidence from the Police aimed to bridge the gap in the literature.

The results were not statistically significant between the three occupations ( $\chi^2 (2) = 4.525$ , p=0.104) with mean ranks for the Police 175.00, Fire 186.13, and Ambulance 202.09. No post hoc tests were carried out due to the non-significance.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	1.3	15.0	46.9	24.4	12.5
<b>Fire (n=113)</b>	0	7.1	53.1	31.9	8.0
<b>Ambulance (n=97)</b>	0	6.2	47.4	30.9	15.5

**Table 4.22:**

**Frequency for “Drivers seem to panic when they see an emergency vehicle with “blue lights” operating” (question 27)**

An analysis of the frequency results showed that 16.3% of the Police respondents believed civilian drivers rarely or never panicked upon seeing an emergency vehicle. This is more than double the responses from either the Fire or Ambulance service. The Ambulance service had the strongest belief of civilian drivers panicking with 46.4% of the respondents believing this “most of the time” or “definitely”, compared to 39.9% for the Fire service and 36.9% from the Police.

#### **4.8.4 Stress compared to a perception of civilian driving**

To confirm if there was a relationship between emergency driver self-reported stress (paragraph 4.8.1) and how they perceive civilians to drive (paragraph 4.8.3), the non-parametric Spearman’s test of correlation was applied, and this showed a positive medium correlation. Cohen (1988) suggested that a small correlation was  $r = 0.10$  to  $0.29$ , medium correlations  $r = 0.30$  to  $0.49$  and large  $r = 0.50$  to  $1.0$ . For all three services there was a medium and positive correlation which was statistically significant, with the Police ( $N = 160$ ,  $r_s = 0.408$ ,  $p < 0.001$ ), for the Fire service ( $N = 113$ ,  $r_s = 0.314$ ,  $p = 0.001$ ), and the Ambulance service ( $N = 97$ ,  $r_s = 0.336$ ,  $p = 0.001$ ).

#### **4.8.5 Individual Stress Management**

It was hypothesised that the three emergency services would be equally willing to discuss their feelings, following a difficult or traumatic call. In order to test this, two single questions were created.

#### 4.8.5.i

*Question 15 – “Following a difficult or traumatic call I would discuss my feelings with colleagues afterwards”*

The results were statistically significant between the three occupations ( $\chi^2 (2) = 33.033$ ,  $p<0.001$ ). The mean ranks for the Police were 159.81, Fire 178.57, and Ambulance 235.95 with the Ambulance service suggesting they would be most likely to discuss their feelings and the Police the least likely. To test for where the differences between the groups lay, post hoc tests were applied with significant differences between the Police and Ambulance ( $U=4547.00$ ,  $Z=-5.725$ ,  $p<0.001$ ), and Fire and Ambulance ( $U=3799.50$ ,  $Z=-3.944$ ,  $p<0.001$ ). The difference in the sample between the Police and Fire was not statistically significant and the results are shown in Appendix 8.

The results suggested that the Police appeared least likely to discuss feelings with a colleague whereas the Ambulance service were the most likely to discuss feelings themselves overall.

#### 4.8.5.ii

*Question 26 – “Following a difficult or traumatic call emergency service drivers should discuss their feelings with colleagues”*

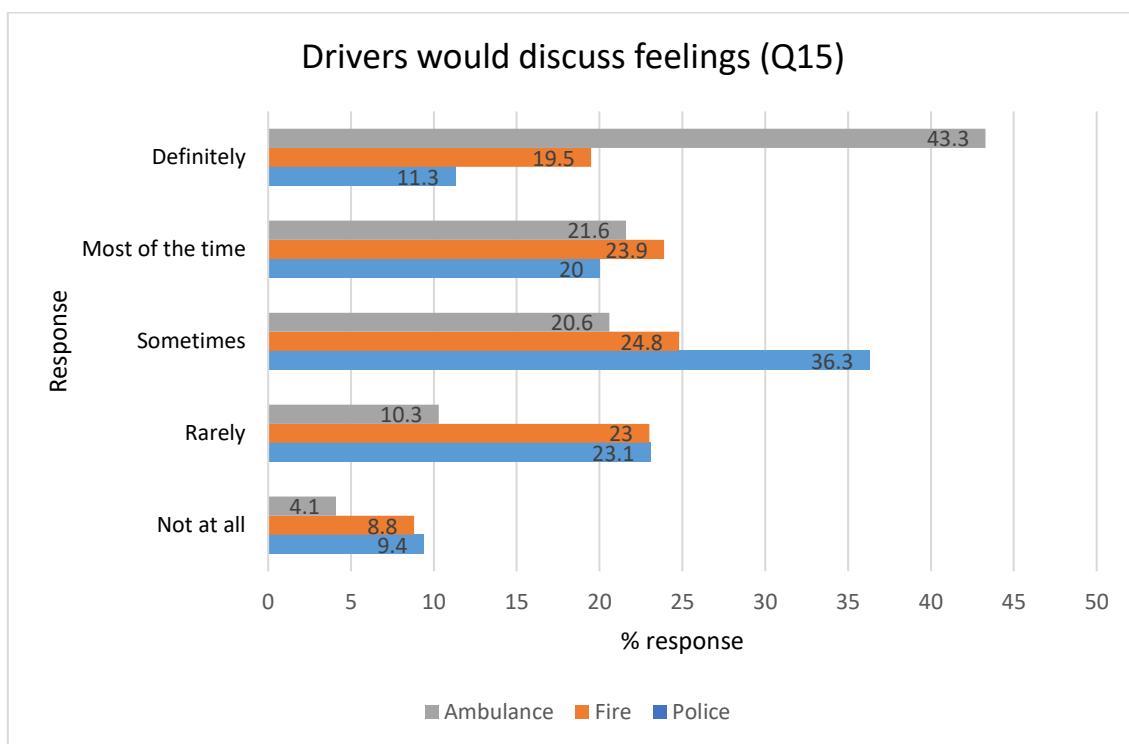
Question 26 asked a variation on the above to establish if the drivers should, as an occupation, discuss feelings. It was hypothesised that there would be no difference in the belief that drivers should discuss feelings with colleagues within each occupation.

The results were statistically significant ( $\chi^2 (2) = 29.688$ ,  $p<0.001$ ) with mean ranks for the Police 160.62, Fire 180.57 and the Ambulance 232.28. The results indicate that the Ambulance service thought that emergency service drivers should discuss their feelings with colleagues whilst the Police did not have a strong tendency towards this. A Post hoc test was applied and statistically significant pairwise differences were found between the Police and Ambulance ( $U=4754.50$ ,  $Z=-5.430$ ,  $p<0.001$ ), and the Fire and Ambulance ( $U=3948.00$ ,  $Z=-3.656$ ,  $p<0.001$ ). The results can be found in Appendix 9. Analysis of the mean rankings showed the Police appear least likely

overall to recommend that their colleagues discussed feelings whilst the Ambulance service most likely overall although the sample difference between the Fire and Ambulance service was not statistically significant.

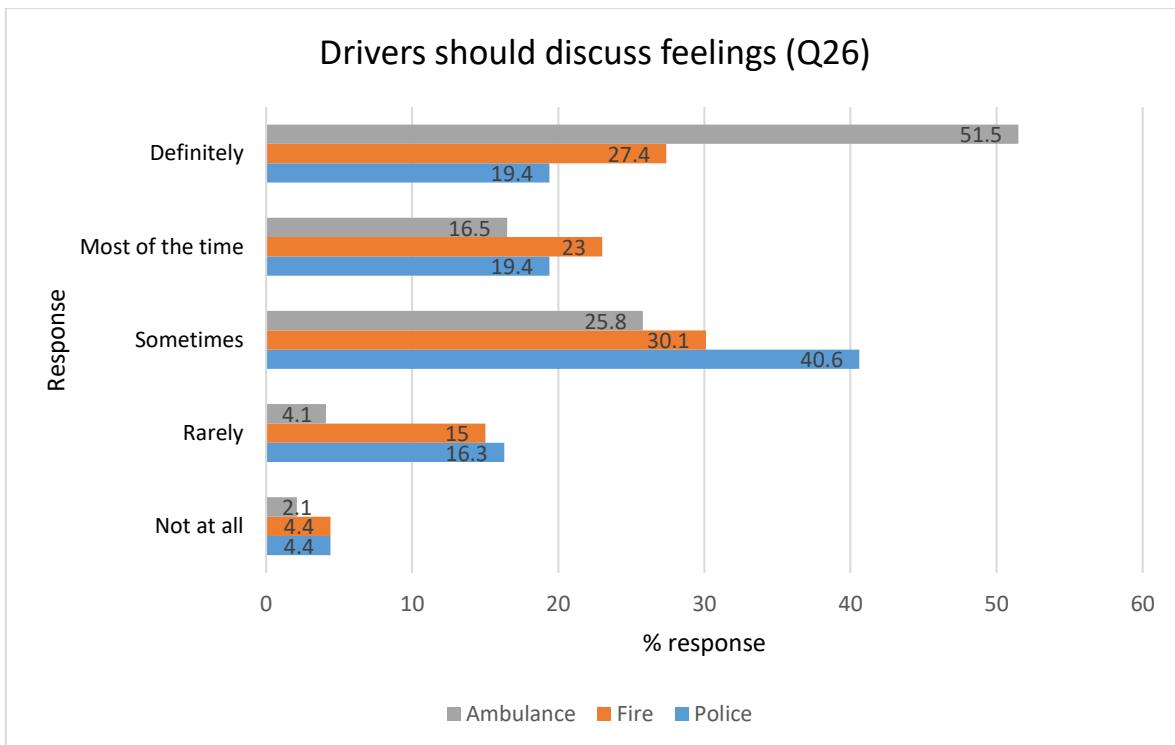
#### *Comparison of responses between question 15 and 26*

In order to establish if the respondents who answered in a specific way for question 15, answered in the same way for question 26, a review of the frequency and subsequent correlation for each emergency service was analysed.



**Figure 4.1: Question 15 responses by %**  
**“Following a difficult or traumatic call I would discuss my feelings with colleagues afterwards”**

An analysis of the frequencies between each of the occupations (Figure 4.1) showed that the Ambulance Service were 3.8 times more likely than the Police to “definitely” want to discuss their feelings with a colleague.



**Figure 4.2: Question 26 responses by %**

**“Following a difficult or traumatic call Emergency service drivers should discuss their feelings with colleagues”**

An analysis of the frequencies for whether drivers should discuss their feelings (Figure 4.2) showed that between each of the occupations the Ambulance Service were 2.65 times more likely than the Police to suggest that a colleague should discuss their feelings. More respondents believed that colleagues should “definitely” discuss their feelings compared to those who would do so. The respondents overall believed colleagues should discuss feelings more than when compared to those who would do so themselves.

To confirm if there was a relationship between those drivers who should discuss their feelings against those who would, the non-parametric Spearman’s test of correlation was applied to each of the services individually. For all three services there was a strong positive correlation which was statistically significant, with the Police ( $N = 160$ ,  $r_s = 0.600$ ,  $p < 0.001$ ), for the Fire service ( $N = 113$ ,  $r_s = 0.678$ ,  $p < 0.001$ ), and the Ambulance service ( $N = 97$ ,  $r_s = 0.561$ ,  $p < 0.001$ ).

#### 4.8.6 Individual Coping

Seven individual questions were asked of the respondents in the questionnaire and to review their overall response these have been compiled into a composite score within SPSS. The questions were 1, 11, 18, 21, 28, 33, and 36.

In order to analyse the results of this composite, questions 18, 33 and 36 were subsequently reverse coded in SPSS. This was to ensure the questions were all in the same direction in relation to the positivity of the question tone compared to others in the composite. Cronbach alpha measured 0.526 for internal consistency (Robinson et al. 1991) on the composite score which is considered low for internal consistency despite the questions being extracted from a previously validated questionnaire. Subsequently the composite score was abandoned, and each question was subsequently analysed individually.

##### 4.8.6.i

*Question 1 - “I always make an effort to stay calm and relaxed around other road users whilst responding”*

The question was asked how calm emergency drivers remain, to gain insight into whether they have effective coping mechanisms and managing any feelings of stress or frustration. The results were statistically significant ( $\chi^2(2) = 11.657$ ,  $p=0.003$ ), with mean ranks for the Police were 196.01, Fire 196.64 and Ambulance 158.33. The post hoc tests showed that the pairwise difference for the Police and Ambulance ( $U=6181.00$ ,  $Z=-3.176$ ,  $p=0.001$ ), and the pairing Fire and Ambulance ( $U=4424.00$ ,  $Z=-2.781$ ,  $p=0.005$ ) there was a statistically significant difference. However, the Police and Fire pairing was not statistically significant.

	Not at all	Rarely	Sometimes	Most of the time	Definitely
%					
<b>Police (n=160)</b>	0	0	1.3	33.8	65.0
<b>Fire (n=113)</b>	0	0	0.9	35.4	63.7
<b>Ambulance</b> <b>(n=97)</b>	1.0	0	0	54.6	44.3

**Table 4.23: Frequency for “I always make an effort to stay calm and relaxed around other road users whilst responding” (question 1)**

From the frequency analysis (Table 4.23) the Ambulance respondents were the least likely to report remaining calm. The Ambulance service were 1.4 times less likely to reply they would “definitely” stay calm when compared to the Police or Fire service. The Ambulance however were 1.5 times more likely to reply they would stay calm “most of the time” as compared to the other services. There was little difference in responses between the Police and Fire who reported similar levels of coping whilst responding.

#### 4.8.6.ii

*Question 11 – “I am usually patient with others when on emergency response as others may not be as experienced”*

Emergency drivers were also asked how patient they remained. This was due to the possibility that “expert” drivers may feel frustration around those they believe are less skilled as discussed in the literature review. The results were not statistically significant ( $\chi^2(2) = 0.375$ ,  $p=0.829$ ), where the mean ranks for the Police were 187.84, Fire 186.51 and Ambulance 180.46. No post hoc test was carried out.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	1.9	1.9	8.8	48.1	39.4
<b>Fire (n=113)</b>	1.8	0.9	5.3	56.6	35.4
<b>Ambulance (n=97)</b>	1.0	2.1	8.2	54.6	34.0

**Table 4.24: Frequency for “I am usually patient with others when on emergency response as others may not be as experienced” (question 11)**

An analysis of the frequency (Table 4.24) showed no real difference between any of the services who all reported similar levels of patience towards other road users across the responding scale.

#### 4.8.6.iii

*Question 18 - “Whilst responding, when irritated by another road user I drive more aggressively”*

The two previous questions focused on positive emotions whereby this question asked drivers how they may externalise their emotions if they are feeling frustrated or irritated. There was a statistically significant result between the three occupations ( $\chi^2(2) = 25.381$ ,  $p<0.001$ ), with mean ranks for the Police were 166.71, Fire 185.35 and Ambulance 216.66. Post hoc tests determined statistical significance between all the pairings. (Police/Fire  $U=8116.00$ ,  $Z=-2.252$ ,  $p=0.024$ , Police/Ambulance  $U=5677.50$ ,  $Z=-5.011$ ,  $p<0.010$ , Fire/Ambulance  $U=4540.00$ ,  $Z=-2.678$ ,  $p=0.007$ ). When the Bonferroni adjustment was made the pairing for the Police and Fire was however not statistically significant where  $\alpha_{altered}$  was 0.017.

A review of the frequency for each service was also conducted.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	88.1	9.4	2.5	0	0
<b>Fire (n=113)</b>	77.9	17.7	4.4	0	0
<b>Ambulance (n=97)</b>	61.9	25.8	10.3	2.1	0

**Table 4.25: Frequency for “Whilst responding, when irritated by another road user I drive more aggressively” (question 18)**

The Police were the most likely to report less driving aggression and therefore remaining calmer when irritated by another road user. This is in comparison to the Ambulance service who were over 4 times more likely to respond that they would “sometimes” drive more aggressively than the Police would (Table 4.25).

#### 4.8.6.iv

*Question 21 – “I always try to stay detached or distanced from the situation whilst I am responding”*

Driver were asked if they stayed detached from a situation which can be an indication of an avoidance coping mechanism (Dorn, Stephen, af Wåhlberg and Gandolfi, 2010) and as such maladaptive.

There was no statistically significant difference between each occupation ( $\chi^2(2) = 4.350$ ,  $p=0.114$ ), where the mean ranks for the Police were 184.04, Fire 173.11 and Ambulance 202.34 and as such no post hoc test was carried out.

A review of the frequencies showed that 50.5% of the Ambulance service respondents reported that they tried to stay detached “most of the time” but this compared to 37.5% for the Police and 38.9% for the Fire Service. This suggested that the Ambulance service were deploying better overall coping than the other services.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	11.9	8.8	24.4	37.5	17.5
<b>Fire (n=113)</b>	16.8	6.2	24.8	38.9	13.3
<b>Ambulance (n=97)</b>	4.1	5.2	25.8	50.5	14.4

**Table 4.26: Frequency of “I always try to stay detached or distanced from the situation whilst I am responding” (question 21)**

#### 4.8.6.v

*Question 28 – “When on response I am patient with other road users, so they do not feel under pressure”*

The question was asked to each of the services as part of the thesis to consider how civilians react around an emergency vehicle. Civilian drivers may react in an adverse manner through their own late awareness or distraction but may equally make an error due to the driving manner of the emergency vehicle itself. The Police respondents' results contribute to the overall picture when later analysing Police driving through the medium of video footage.

There was no statistically significant result between the pairings ( $\chi^2(2) = 5.224$ ,  $p=0.073$ ), where the mean ranks for the Police were 193.99, Fire 190.08 and Ambulance 166.16. No post hoc test was considered.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	1.9	5.0	6.3	43.8	43.1
<b>Fire (n=113)</b>	2.7	3.5	7.1	46.0	40.7
<b>Ambulance (n=97)</b>	3.1	2.1	13.4	52.6	28.9

**Table 4.27: Frequency of “When on response I am patient with other road users, so they do not feel under pressure” (question 28)**

An analysis of frequency showed that the Police and Fire service reported results across the scale. The Ambulance service appeared to feel or show less patience with other road users, as 28.9% of drivers for this service would “definitely” be patient, compared to 40.7% for the Fire service and 43.1% for the Police service.

#### 4.8.6.vi

*Question 33 - “Under ordinary driving conditions when irritated by another road user I drive more aggressively”*

Question 18 considered how an emergency driver may react if frustrated by another road user, under emergency driving conditions. Question 33 has asked the same question but asked for respondents to consider if they felt the same level of emotion under ordinary driving conditions.

There was a statistically significant difference between the three occupations ( $\chi^2(2) = 34.672$ ,  $p<0.001$ ), where the mean ranks for the Police were 154.23, Fire 211.49 and Ambulance 206.81. The post hoc test showed that the Police and Fire pairing was statistically significant ( $U=6282.00$ ,  $Z=-5.366$ ,  $p<0.001$ ), as was the Police and Ambulance ( $U=5514.00$ ,  $Z=-4.940$ ,  $p<0.001$ ). Results can be found in Appendix 9.

	Not at all	Rarely	Sometimes	Most of the time	Definitely
	%				
<b>Police (n=160)</b>	83.1	10.3	6.3	0	0
<b>Fire (n=113)</b>	53.1	28.3	14.2	3.5	0.9
<b>Ambulance (n=97)</b>	53.6	33.0	12.4	1.0	0

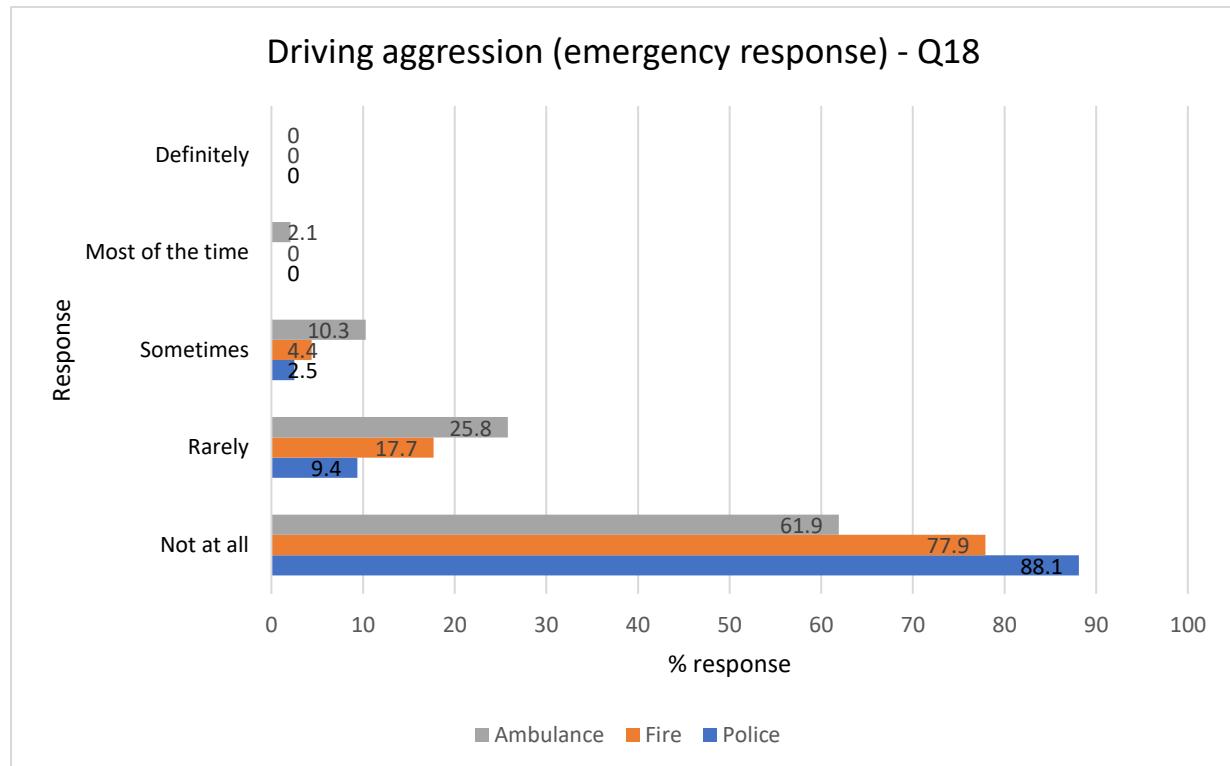
**Table 4.28: Frequency for “Under ordinary driving conditions when irritated by another road user I drive more aggressively” (question 33)**

The Fire service reported the highest likelihood of driving aggressively when irritated under ordinary conditions. This differed from the emergency driving condition whereby the Ambulance service reported higher levels of driving aggression. The Police respondents were the least likely to drive aggressively as shown by the frequencies in

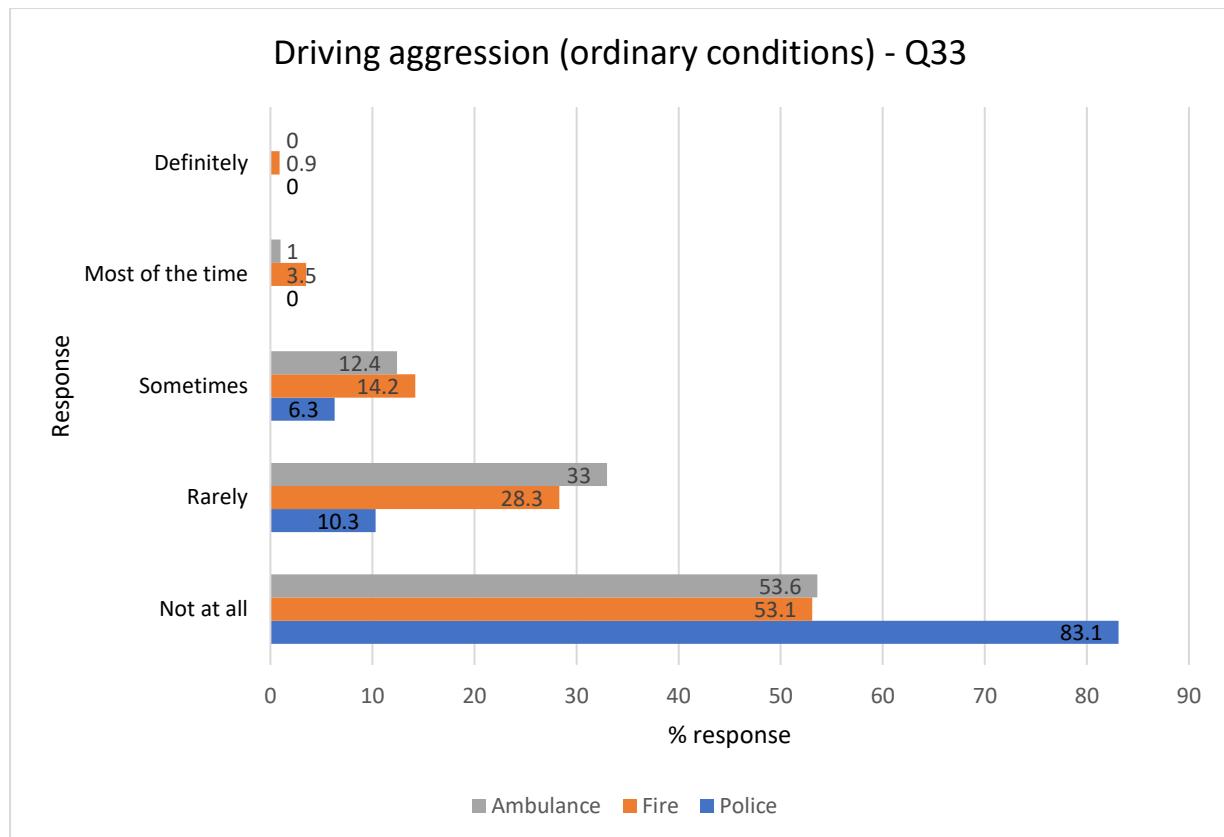
Table 4.28 where 83.1% of Police drivers reported “not at all”. The difference between the Fire and Ambulance was not significant so it is possible the results were by chance.

*Comparison of responses between question 18 and 33*

A comparison between how respondents reported driving aggression between the two states of ordinary and emergency response driving was carried out and the frequencies across both states is illustrated in Figure 4.3 - 4.4.



**Figure 4.3: Graph of Q18 – “On an emergency when irritated by another road user I drive more aggressively”**



**Figure 4.4: Graph of Q33 - “Under ordinary driving conditions when irritated by another road user I drive more aggressively”**

The Fire Service reported driving more aggressively when irritated under ordinary driving conditions. 77.9% of Fire service drivers reported never driving aggressively if irritated when on an emergency but accounted for 53.1% whilst under ordinary driving conditions, illustrating a maladaptive coping strategy.

To establish any relationship between non-emergency and emergency conditions a Spearman test of correlation was applied between question 18 and 33 for the services individually. For the Police and Ambulance services there was a strong positive correlation which was statistically significant, with the Police ( $N = 160$ ,  $r_s = 0.519$ ,  $p < 0.001$ ), and the Ambulance service ( $N = 97$ ,  $r_s = 0.598$ ,  $p < 0.001$ ). There was a medium correlation for the Fire Service ( $N = 113$ ,  $r_s = 0.351$ ,  $p < 0.001$ ) based on Cohen (1988).

#### 4.8.6.vii

*Question 36 – “It is important to let other drivers know they were at fault if they impede my emergency progress”*

A further question also considered additional coping strategies and whether the services were using adaptive or maladaptive methods. There was a statistical difference between the occupations ( $\chi^2(2) = 15.644$ ,  $p<0.001$ ), where the mean ranks for the Police were 208.10, Fire 164.12 and Ambulance 173.12. The post hoc tests showed that the Police and Fire pairing was statistically significant ( $U=6882.50$ ,  $Z=-3.658$ ,  $p<0.001$ ), as was the Police and Ambulance ( $U=6301.00$ ,  $Z=-2.730$ ,  $p=0.006$ ). Results can be found in Appendix 9. However, the difference in the pairing between the Fire and Ambulance was not statistically significant.

Although the Police have shown better coping than the other services, they have however shown that they are most likely to let other drivers know if they have impeded progress. Police respondents stating that they “never” or “rarely” let another driver know they were at fault accounted for 76.2%, which increased to 87.6% for the Fire Service and 85.6% for the Ambulance service.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	40.6	35.6	18.8	3.1	1.9
<b>Fire (n=113)</b>	62.8	24.8	10.6	0.9	0.9
<b>Ambulance (n=97)</b>	58.8	26.8	9.3	2.1	3.1

**Table 4.29: Frequency for “It is important to let other drivers know they were at fault if they impede my emergency progress” (question 36)**

#### 4.8.7 Drivers sense of their own ability

The emergency service drivers were asked to rate their experience and confidence levels along with an indication of risk taking tendencies. Questions 2, 7, 10, 13 and 14 had been combined into a composite score but the test for internal validity showed for this composite a Cronbach alpha of 0.214 which was not considered acceptable. As

a result, the composite score was abandoned and although the score was formed from those of other validated questionnaires a separate analysis of each individual question was conducted.

#### 4.8.7.i

##### *Question 2 - “I feel confident in my ability to avoid a collision whilst responding”*

The question was asked to provide a greater insight into how skilled or experienced an emergency driver may feel. The DBI originally included the question under a “dislike of driving” group as the less confident a driver felt the higher the level of anxiety experienced. The Police responses were later considered in conjunction with other evidence gathered to try to establish if Police drivers can influence how civilian drivers may react when the emergency vehicle is passing through. There was a significant difference between the services ( $\chi^2(2) = 19.334$ ,  $p<0.001$ ), where mean ranks for the Police were 208.92, Fire 174.57 and Ambulance 159.60. The post hoc tests showed that the Police and Fire pairing was statistically significant ( $U=7347.50$ ,  $Z=-3.080$ ,  $p=0.002$ ), as was the Police and Ambulance ( $U=5705.00$ ,  $Z=-4.120$ ,  $p<0.001$ ). Results can be found in Appendix 9.

An analysis of frequencies shows that the Police “definitely” felt confident in their ability to avoid a collision (and as such lower levels of anxiety based on Glendon et al. 1993). 65.6% of Police respondents felt this confident (1.6 times more than the Ambulance service) compared to 46.9% from the Fire service and 40.2% from the Ambulance.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	0	0	0	34.4	65.6
<b>Fire (n=113)</b>	0	0	0	53.1	46.9
<b>Ambulance (n=97)</b>	0	0	3.1	56.7	40.2

**Table 4.30: Frequency for “I feel confident in my ability to avoid a collision whilst responding” (question 2)**

This may add insight to the later chapter which analysed actual Police collisions. The Ambulance service reported being the least confident overall and may show a realistic appraisal of their own ability as they reported the highest number of collisions overall in the demographics.

#### 4.8.7.ii

*Question 7 - “When on “blue lights” I think I have enough experience and training to deal with risky situations on the road safely”*

A question was also asked about perceived skill and ability for risky situations and a different pattern of responses occurred. The results showed a statistical significance ( $\chi^2(2) = 12.909$ ,  $p=0.002$ ), where the mean ranks for the Police were 182.93, Fire 209.23 and Ambulance 162.09. The post hoc test established a statistically significant difference for the Police and Fire ( $U=7732.00$ ,  $Z=-2.294$ ,  $p=0.022$ ), and the Fire and Ambulance ( $U=4106.50$ ,  $Z=-3.474$ ,  $p=0.001$ ). Results can be found in Appendix 9.

The Fire service were much more certain of their ability to deal with a risky situation than as 51.3% felt they could “definitely” deal with the situation. This was much higher than the Police or Ambulance in this state and is not what would have been expected as a collision could also be considered a risky situation. However, the pairing between occupations for the Police and Ambulance was not statistically significant.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	1.3	1.3	4.4	55.6	37.5
<b>Fire (n=113)</b>	0	0.9	3.5	44.2	51.3
<b>Ambulance (n=97)</b>	2.1	5.2	8.2	53.6	30.9

**Table 4.31: Frequency for “When on “blue lights” I think I have enough experience and training to deal with risky situations on the road safely” (question 7)**

The Ambulance service have reported that they feel they have the least experience to deal with risky situations and this is similar to the previous question where they did not have confidence to avoid a collision.

#### 4.8.7.iii

##### *Question 10 - “On response I overtake whenever possible”*

The DBI (Glendon et al. 1993) included this question as part of consideration for driving aggression. It was hypothesised in the DBI literature that where a driver could not overtake it would increase frustration. Between occupations there was a statistically significant result ( $\chi^2(2) = 20.830$ ,  $p<0.001$ ), where the mean ranks for the Police were 157.84, Fire 201.45 and Ambulance 212.55. Post hoc tests showed a statistical difference between the Police and Fire pairing ( $U=6890.00$ ,  $Z=-3.460$ ,  $p=0.001$ ), and the Police and Ambulance ( $U=5484.00$ ,  $Z=-4.070$ ,  $p<0.001$ ). Results can be found in Appendix 9.

	Not at all	Rarely	Sometimes	Most of the time	Definitely
	%				
<b>Police (n=160)</b>	10.6	18.1	30.6	28.1	12.5
<b>Fire (n=113)</b>	6.2	8.0	25.7	39.1	22.1
<b>Ambulance (n=97)</b>	2.1	14.4	16.5	41.2	25.8

**Table 4.32: Frequency for “On response I overtake whenever possible” (question 10)**

All those who drive for the emergency services, and have a specified level of driving qualification, are authorised to drive faster than civilians, and break traffic laws if justified in their goal to arrive at an emergency. Therefore, overtaking would be part of that driving requirement. The Police, despite being able to drive faster on average due to their vehicle type, have reported showing more signs of caution than that from the other services. The responses from the Fire and Ambulance showed 61.2% and 67% respectively would overtake “most of the time” or “definitely” do so, compared to just 40.6% of Police drivers.

## 4.8.7.iv

*Question 13 - “Whilst operating with “blue lights” and sirens driving gives me a sense of power”*

Originally included on the DBI aggression scale this question was used in this thesis to help establish how effective emergency drivers coping may be, when driving on emergency response for work. There was a statistically significant difference between the occupations ( $\chi^2(2) = 28.735$ ,  $p<0.001$ ), where the mean ranks for the Police were 156.95, Fire 206.52 and Ambulance 208.11. Post hoc tests established a statistical significance between the pairings for the Police and Fire ( $U=6643.00$ ,  $Z=-4.674$ ,  $p<0.001$ ), and the Police and Ambulance ( $U=5589.00$ ,  $Z=-4.719$ ,  $p<0.001$ ). Results can be found in Appendix 9.

%	Not at all	Rarely	Sometimes	Most of the time	Definitely	$\bar{x}$
<b>Police (n=160)</b>	81.9	9.4	6.3	1.9	0.6	1.30
<b>Fire (n=113)</b>	55.8	21.2	15.0	7.1	0.9	1.76
<b>Ambulance (n=97)</b>	53.6	24.7	17.5	2.1	2.1	1.74

**Table 4.33: Frequency for “Whilst operating with “blue lights” and sirens driving gives me a sense of power” (question 13)**

The frequency results show that the Police reported the lowest levels of feelings of power (Table 4.33) between the respondents when operating with the emergency warning systems. This suggests the Police may feel lower levels of aggression while driving under response, compared to the Fire and Ambulance although the Fire and Ambulance pairing was not found to be statistically significant. The results from this question provided a useful insight into the views of Police officers when comparing additional data gathered from collision data and video footage.

#### 4.8.7.v

*Question 14 – “I think it is worth taking risks when on response to get to an emergency quicker”*

Adapted for emergency response driving and originally included on the DBI aggression scale this question considered how effective the coping mechanisms were. Drivers who took more risks were also found to be feeling frustrated and overtaking was the aggressive action to mitigate the feelings (but is considered maladaptive). There was a statistically significant difference ( $\chi^2(2) = 29.095$ ,  $p<0.001$ ), where the mean ranks for the Police were 166.99, Fire 218.29 and Ambulance 177.84. The post hoc test determined a statistical significance between the pairings for the Police and Fire ( $U=6537.00$ ,  $Z=-5.159$ ,  $p<0.001$ ), and the Fire and Ambulance ( $U=4278.00$ ,  $Z=-3.374$ ,  $p=0.001$ ). Results can be found in Appendix 9.

	Not at all %	Rarely	Sometimes	Most of the time	Definitely
<b>Police (n=160)</b>	86.3	11.3	2.5	0	0
<b>Fire (n=113)</b>	59.3	28.3	10.6	0.9	0.9
<b>Ambulance (n=97)</b>	80.4	15.5	4.1	0	0

**Table 4.34: Frequency for “I think it is worth taking risks when on response to get to the emergency quicker” (question 14)**

An analysis of the frequency showed that the Fire service were more likely to report taking risks to arrive at an emergency quicker. Whilst the Police said they never would (86.3%) alongside the Ambulance service (80.4%), just 59.3% of Fire respondents reported “not at all”. All respondents (n=370) except for 1.8% of Firefighters reported that they would not take risks, rarely or only sometimes.

#### 4.8.8 Emergency driver skill level

Three separate questions were asked in the questionnaire which asked the respondents, all emergency service drivers, to grade the skills held by drivers from the Police, Fire and Ambulance. The expectation based on previous literature was that a

driver when asked about their own service's driving would rate it higher than the other two would about the same service.

#### 4.8.8.i

##### *Question 12 – “Drivers for the Fire Service are highly skilled”*

There was a statistically significant difference between the three occupations ( $\chi^2(2) = 10.108$ ,  $p=0.006$ ), where the mean ranks for the Police were 174.35, Fire 210.49 and Ambulance 174.78. From the rankings the Fire Service have rated themselves as highly skilled and more so than their peers in the other emergency services have done. A post hoc test showed that the pairwise differences between the Police and Fire ( $U=7193.00$ ,  $Z=-3.109$ ,  $p=0.002$ ), along with the Fire and Ambulance ( $U=4504.00$ ,  $Z=-2.433$ ,  $p=0.015$ ), were significant and the results are in Appendix 9.

#### 4.8.8.ii

##### *Question 19 – “Ambulance drivers are highly skilled”*

Question 19 asked if Ambulance drivers were highly skilled with the expectation that the Ambulance drivers would see themselves as more highly skilled than their peers had rated them from the Police and Fire service. There was a statistically significant difference ( $\chi^2(2) = 10.621$ ,  $p=0.005$ ), where mean ranks for the Police were 178.21, Fire 171.63 and Ambulance 213.68. From the rankings the Fire Service rated themselves as highly skilled and more so than their peers in the other emergency services have done. A post hoc test showed that the pairwise differences between the Police and Ambulance ( $U=6300.50$ ,  $Z=-2.679$ ,  $p=0.007$ ), along with the Fire and Ambulance ( $U=4206.50$ ,  $Z=-3.132$ ,  $p=0.002$ ), were statistically significant and the results are in Appendix 9.

#### 4.8.8.iii

##### *Question 29 – “Police drivers are highly skilled”*

The final question examining this self-ranking of skill was question 29 which asked if Police drivers were highly skilled and was asked of all respondents. There was a statistically significant difference between the occupations ( $\chi^2(2) = 19.066$ ,  $p<0.001$ ),

and the mean ranks for the Police were 165.05, Fire 183.85 and Ambulance 221.14. The post hoc test showed that the pairings were statistically significant between the Police and Ambulance ( $U=5439.00$ ,  $Z=-4.279$ ,  $p<0.001$ ), and the Fire and Ambulance ( $U=4344.00$ ,  $Z=-2.764$ ,  $p=0.006$ ).

The results from questions 12 and 19 found that each occupation rated themselves higher as skilled drivers, than the others have done so, when considering their own driving. As the statistical tests showed, the Police did not rate themselves higher on skill, and actually rated themselves lower, which would have been otherwise expected (Alicke and Govorun, 2005) and as shown by the Mean ranks. The Fire and Ambulance service rated the Police more highly skilled than the Police have done themselves. It should be noted that the pairing between the Police and Fire service was not statistically significant.

#### **4.9 Results Summary**

##### ***Police***

Police respondents reported feeling the least stress when interacting with other road users under emergency response conditions and reported feeling the most patient. Both the Police and Fire service reported similar levels of feeling calm around other road users, a level lower than the Ambulance service.

The Police were found to report the least driving aggression when irritated by the actions of another road user (in both emergency and non-emergency conditions) and were the most positive about the reactions of a civilian driver who was interacting with their own emergency vehicle.

In respect to how the respondents believed they coped with a situation the Police were the least likely to want to discuss their feelings, when compared to the Fire and Ambulance services. The Police were also the least likely to let other drivers know they were at fault. The Police and Fire service had similar levels of responses when asked if they distanced or detached themselves from a situation, a maladaptive strategy. The Ambulance service reported higher levels of detachment.

For driving ability, the Police felt the most confident in their ability to avoid a collision but also reported the most caution and were least likely to overtake, despite having the most powerful vehicle of the three services. The Police did not believe that the emergency warning systems gave them a sense of power, resulting in a behavioural change.

When asked to consider the driving of each service the Police thought they themselves, were less skilled than the opinion of the Ambulance Service and Fire Service who rated the Police Service drivers higher.

### ***Fire Service***

The respondents reported feeling the most stressed under non-emergency conditions when interacting with other road users which was not found in emergency conditions. The Police and Fire Service felt similar levels of patience towards other road users, with the Ambulance drivers less so.

The Fire Service were most certain in their ability to deal with risky situations and believed it was worth taking risks to get to an emergency quicker.

When asked to consider the driving of each service the Fire Service thought they were the most skilled compared to the opinion of the Police Force and Ambulance drivers. Both the Fire and Ambulance Service reported similar feelings towards the effect of emergency warning systems on giving them a sense of power, with the Police reporting lower levels, as previously stated.

### ***Ambulance***

Under emergency driving conditions the respondents from the Ambulance Service reported feeling the most stress when interacting with other road users and were the least patient. They were also the most negative towards a civilian driver's reaction when they were interacting during the response. Similarly, the Ambulance Service respondents were the least likely to remain calm around other road users and reported the highest levels of driving aggression when irritated by another road user. For a

non-emergency response, the Fire Service reported the highest aggressive driving levels.

Ambulance respondents were most likely to let other drivers know they believed were at fault but were more likely to want to discuss their feelings, than the Police or Fire Services. Whilst discussion is a positive coping mechanism the Ambulance Service drivers were the most likely to remain detached or distanced from a situation when responding (avoidance coping).

When asked to consider their driving the Ambulance Service drivers, reported the least confidence in their ability to avoid a collision and to be able to deal with risky situations. However, they were most likely to overtake wherever possible. During a response the Ambulance and Police Service drivers were less likely to take risks to get to an emergency quicker than the Fire Service.

The Ambulance Service drivers rated their own driving skill as higher than that considered by the Police and Fire Services.

For all Services there were similar feelings towards the question that collisions are caused by other road users, with no real difference. However, for all, this was also a low percentage rate as 10.6% of Police Force drivers reported they believed this to be the case 'most of the time' or 'definitely', compared to 13.3% of Fire Service drivers and 14.4% of Ambulance drivers.

## Chapter 5: Analysis of collisions between Police and civilian vehicles (Study 2)

### 5.1 Introduction

It is suggested that road collisions are caused through the interplay of road, vehicle and driver error (Sabey and Taylor, 1980). More specifically researchers now understand that within the driver element, individual differences can influence behaviours. The notion of “Red mist” (Dorn et al. 2003), previously discussed in Chapter 2, is a term used to describe the single-minded pursuit of a goal, and has been inferred to be in part, the cause of an increase in Police collisions. A review of the available Police collision reports, known as a “POLAC”, obtained from South Wales Police Force, showed the details were factual with no mention of behaviours or emotions which could have potentially clouded a Police driver’s judgement. If the full causation facts of a collision are not investigated then it would be difficult for lessons to be learned in the future (Reason, 1990).

Earlier chapters in this thesis have found that there are many inferences to the way civilians are perceived to drive when moving out of the way of an emergency vehicle, but no deeper research was found to support those. (Saunders et al. 2003; Nakatani et al. 2009; USFA, 2014a). The study conducted in chapter 3 (pilot) and chapter 4 (study 1) asked emergency drivers several questions in a questionnaire survey designed to i) establish whether they believed that civilian drivers were the cause of collisions between them and ii) to evaluate the level frustration they may have felt whilst driving. Using evidence gathered from a Police database, this current chapter looked at whether civilian drivers were predominately liable for the collisions and if the type of Police vehicle (marked or unmarked) or time of day affected the proportionality.

Drucker et al. (2013) investigated collisions with civilians and emergency vehicles of varying types but as with other studies did not specifically consider the apportionment of liability (Kahn, Pirrallo and Kuhn, 2001; Custalow et al. 2004; Plecas et al. 2014) merely that the crash took place between the parties. Drucker et al. (2013) split time into unequal blocks and found that for non-fatal crashes with an emergency vehicle

35.6% occurred between 11am and 4pm, 20.8% between 5pm to 8pm, 22.6% between 9pm to 5am and 21% between 6am and 10am. It should be noted that a distinction between the studies of Drucker et al. (2013) and Custalow et al. (2004) was that the latter reviewed liveried Ambulance collisions only, compared to combined emergency vehicle collisions. One published paper (Plecas et al. 2014) considered unmarked Police vehicles (no emergency warning systems fitted / no livery markings) as a comparison group to marked Police vehicles but not in relation to time of day.

This study conducted both a quantitative and qualitative analysis examining the collisions that have occurred. In addition, analysis of the frequency of collisions according to markings may provide evidence as to which Police vehicles are safer to drive. Previous published studies suggested that a marked vehicle has higher conspicuity (Langham et al. 2002; Custalow et al. 2004) so could be assumed to be a lower risk.

### *5.1.1 Force Geography*

South Wales Police Force is situated in the south of Wales, serving Cardiff, Swansea, Neath Port Talbot, Bridgend, Vale of Glamorgan, Rhondda Cynon Taf and Merthyr Tydfil. The area covers 812 square miles and serves 1.3 million people (42% of the Welsh population). It is the 8<sup>th</sup> largest Force in England and Wales and encompasses all road types (Motorway – M4 travelling West to East, Dual Carriageway, A 'Roads and rural roads) and urbanisations (City, Urban, Residential, Villages). Figure 5.1 illustrates the geography and major conurbations that the Force covers.





**Figure 5.1: Map of South Wales (Ordnance Survey)**

### 5.1.2 Vehicle characteristics

#### Unmarked

An unmarked Police vehicle and therefore one without any livery or high visibility markings will often be deployed for covert and tactical operations. For Roads Policing operations in the UK there is a requirement for high performance vehicles with discreet lighting fitted within the grill (Figure 5.2) and rear windscreens. The College of Policing (College of Policing<sup>8</sup>) guidance stipulates that a high-performance Police vehicle must have a performance of 180PS or higher where 1 PS = 0.99 brake horsepower (BHP).



**Figure 5.2: Example of light fittings on an unmarked Police vehicle**

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<sup>8</sup> College of Policing *Driver/rider levels and vehicle categories* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/?s=high+performance+vehicles>

An unmarked Police vehicle offers some advantages over its marked counterpart. It is better able to offer discreet surveillance, such as within the role of traffic enforcement but the disadvantage is that it would potentially be less visible to other general motorists in the event of responding to an emergency (Solomon et al. 2002). In the event of being involved in a pursuit at both the initial and tactical phase, these vehicles, must follow strict guidelines as laid out by the College of Policing (College of Policing<sup>9</sup>) detailed below:

*"unmarked cars fitted with audio and visual warning equipment driven by tactical phase trained Advanced drivers and deemed fit for use in tactical phase pursuit (Forces should consider replacing "unmarked" vehicles with suitably "marked" vehicles at the earliest opportunity due to the limitations of using "unmarked" vehicles in pursuit).*

*All vehicles that are likely to be involved in pursuits should be equipped with a radio system capable of communicating with control / communications room staff and recording real-time evidence".*

To clarify, the "initial phase" is part of the spontaneous pursuit whereby Police officers with suitable vehicles, trained in pursuits may engage with a civilian driver but do not have authority to use tactical resolutions apart from Tyre-deflation devices. The next phase known as the "tactical phase" gives authority to a suitably qualified driver to bring the pursuit to a conclusion, directed by a Commander within the control centre (College of Policing<sup>10</sup>).

### *Marked*

The vehicle types used within this Police Force vary but for response duties are of both small and large size as defined by Euro NCAP ([www.euroncap.com](http://www.euroncap.com)), including

<sup>9</sup> College of Policing *Road Policing. Police pursuits*. [Online] <https://www.app.college.Police.uk/app-content/road-policing-2/Police-pursuits/>

<sup>10</sup> College of Policing *Road Policing. Police pursuits*. [Online] <https://www.app.college.Police.uk/app-content/road-policing-2/Police-pursuits/>

BMW 3 series and Ford Focus and in some cases, have high powered engine performance (College of Policing<sup>11</sup>). However also included are light vans such as Vauxhall Vito and Minibuses as operational demand dictates.

A marked Police vehicle normally uses standard Battenberg patterns as advised by the UK Home Office (Harrison, 2004) alongside the warning systems of flashing headlights, sirens and “blue lights” (Figure 5.3).



**Figure 5.3: Standard markings on a UK Police vehicle alongside the Emergency Warning Systems**

### 5.1.3 Emergency warning systems (EWS) policy

The fitting of emergency warning systems is ultimately governed by UK Legislation namely the Road Vehicle Lighting Regulations (1989) and Road Vehicles (Construction and Use) Regulations (1986), ([www.legislation.gov.uk](http://www.legislation.gov.uk)). An independently submitted Freedom of Information (FOI) request to South Wales Police (596/15) detailed the following information with regards to the policy and correct usage of the emergency warning equipment.

- *Police drivers should assess when and where to activate emergency equipment. In normal circumstances emergency lights should be activated before sirens.*

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<sup>11</sup> College of Policing *Driver/rider levels and vehicle categories* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/?s=high+performance+vehicles>

- When using sirens, it is often not noise but a change in noise that gains a reaction. The use of the long tone between hazards is appropriate, however changing to a short tone on the approach to a hazard is likely to maximise the benefit of the warning.
- When in close proximity to other road users, particularly cyclists, pedestrians, or animals, careful consideration should be given before activating sirens.
- Following a risk assessment by the Police driver if it is decided not to use all the emergency warning equipment extra care must be taken, as other drivers may be less aware of the Police vehicle's presence.
- When driving in convoy or following another emergency vehicle, a different tone to other vehicles should be used. The public may see one but not expect a second or third.
- Consideration should be given to switching off the sound system in stationary traffic. This often takes the tension out of the situation and gives others time to consider what they might do to help.

#### 5.1.4 Emergency warning system operation

The warning systems are operated by two more common types of control box depending on the vehicle age. The first, an older type is often situated on the dashboard to the left of the steering wheel as shown in Figure 5.4 below.



**Figure 5.4: Older style handset to operate the Emergency warning systems**

The second, newer design, is situated at the bottom of the dashboard near the gear lever (Figure 5.5) and requires the driver to activate a small switch depending on which warning system is required. The sirens once activated can be changed by pressing the horn on the steering wheel which then allows the driver to toggle through the differing tones. For the use of lights, the driver must select the required switch on the panel, thereby taking their eyes off the road.



Example of switches in a Police vehicle which activate the Emergency warning systems

Description of each switch function  
Siren, HLF (Head lights flash), R/Blues (rear), F/Blues (Front)

**Figure 5.5: Positioning of Emergency warning system switches to allow operation**

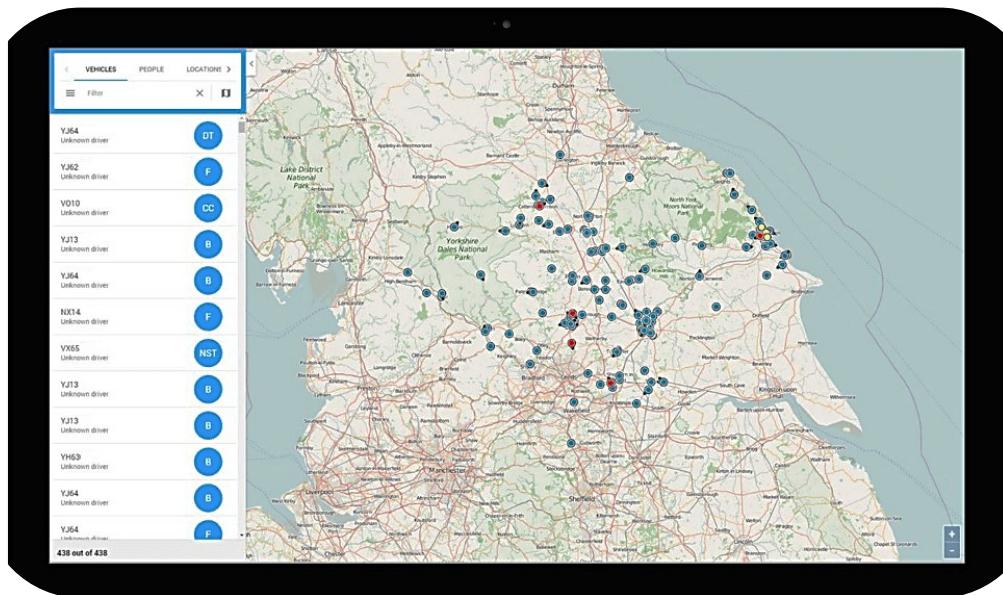
### 5.1.5 Vehicle technology - In-vehicle data recorders (IVDR)

Since 2010 it has been policy within this Police Force to fit all vehicles with in-vehicle data recorders (IVDR). The commercial system chosen known as “IR3+” allows the vehicle’s live location to be tracked in real time, on a computer application by an IVDR operator or manager.

It is possible to retrace any journey a vehicle has undertaken, after the system has been installed in the vehicle, with the system able to identify which emergency warning system (“blue lights”, sirens, flashing headlights) was in operation at any point of the journey (Figure 5.6). The operator can also establish who was driving, vehicle speeds,

whether any of the emergency warning systems were in operation at any one time, and in what combination. Figure 5.6 illustrates the map, seen by the controller, and the location of all Force vehicles which are currently live on IR3+. The controller is able to click on any one of the vehicles to establish who is driving and under what conditions (speed, warning systems)

The continual gathering of data and monitoring provides a database of drivers and their behaviours which would otherwise be difficult to observe (Toledo, Musicant and Lotan, 2008).



**Figure 5.6: Example of the area vehicle tracking as seen by the central operators**

(Source: landaconsultants)

The data is recorded securely and provides the advantage that it can also be reviewed retrospectively, which provides valuable evidence for both legal and research purposes. The fitting of IVDR is now commonplace in Police Forces for evidential purposes (College of Policing<sup>12</sup>) with De Graeve et al. (2003) reporting that where IVDR were fitted into emergency vehicles, the number of collisions subsequently reduced. The following research in this chapter used the data collected from the recorders to establish which warning systems were in use immediately prior to or at

<sup>12</sup> College of Policing ANPR [Online]

<https://www.app.college.Police.uk/app-content/investigations/investigative-strategies/investigative-strategiesanpr/?s=ANPR#limitations>

the point of a collision taking place. The in-vehicle data recorders collect information on the trip start and finish times, acceleration, vehicle speed using GPS, vehicle reaction where it exceeds certain pre-set parameters such as occurrences of harsh braking, or harsh steering (Toledo et al. 2008). The limiting factor is that data that is not noteworthy following a slow speed impact would not be recorded due to no prior driver reaction of any significance, or the event was a “near miss” with another road user. To overcome this some Police Forces now also fit, as part of the IVDR, video surveillance and recording equipment (College of Policing<sup>13</sup>) and this approach is considered further in Chapter 6.

Each Officer is issued with a unique magnetic identifying key which must be logged into the vehicle reader upon starting the engine (see Figure 5.7 below) (Toledo et al. 2008). This allows the data recorder to track or cross-check who the driver was at any point in time should an investigation be later required. The advantage of such a system is that it provides unquestionable evidence of driving style following witness reports, complaints, reported violations, or following a collision. It can both corroborate and provide evidence against the drivers own account (Lehmann and Cheale, 1998; Toledo et al. 2008).



**Figure 5.7: Officer logging into “IR3+” using the unique magnetic identifier key.**

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<sup>13</sup> College of Policing ANPR for response policing. [Online] <https://www.app.college.Police.uk/app-content/road-policing-2/disrupting-criminality/#anpr-for-response-policing>

## 5.2 Research questions

The purpose of this study was to investigate if the marking type for a Police car (marked or unmarked) affected collision liability between the Police vehicle and a third-party vehicle and whether the use of emergency warning systems influenced the liability outcome.

The following research questions were designed for both marked and unmarked Police vehicles to meet the research aims.

**RQ4:** Is liability of collision dependent on whether the Police emergency response vehicle is marked or unmarked?

It was hypothesised that the proportion of collisions for a marked Police vehicle, who were considered liable, should be lower than that of civilians due to the highly visible markings making it easier to see.

It was also hypothesised that for an unmarked Police vehicle, which does not have high visibility markings, and as such should have the same conspicuity as that of the civilian vehicles should not be involved in a greater proportion of collisions than that of the civilian's themselves. In respect of liability (hit third party or hit by third party), for an unmarked vehicle there should be no affect from the vehicle markings.

**RQ5:** Is the frequency of collisions between marked and unmarked Police emergency response vehicles and civilian vehicles dependent on time of day?

The time of day or night that the incident is known to have occurred may have influenced the outcome of liability, potentially due to lower lighting levels making a vehicle more difficult to see or due to the operational demands on the vehicle use. It was hypothesised that an unmarked Police vehicle on emergency response was less visible to another road user and therefore may have a higher collision rate than that of its marked counterpart.

**RQ6:** Does the operation of the Police vehicle emergency warning systems affect the collision liability?

It was hypothesised that there would be a relationship between the use of the emergency warning systems and the proportion of blameworthy collisions that occur for either an unmarked or marked police vehicle.

Following a review of the research results for each vehicle type a direct comparison was made between the two marking types to establish if any conclusions could be drawn.

### **5.3 Methodology**

Access was given to Police Force collision data involving a Police vehicle (of any type and marking) and data gathered between 15<sup>th</sup> December 2010 and 30<sup>th</sup> June 2015.

The purpose of the data collection was to initially establish how many collisions had occurred which involved any type (marked/unmarked/hired) of Police vehicle. Once this had been gathered, causation factors could be summarised based on the brief Fleet description held within the database. The process of data collection involved several stages as the required information was kept over several secure databases and which required separate access. Data collected in this study dated back over a period of 4.5 years. However, as af Wählberg (2009) observed, providing data are not from self-reports, a time-frame of 5 years was found to deliver stable results in terms of future collision prediction.

#### *Stage 1:*

Data, initially supplied from the Fleet Manager, was recorded by the researcher onto a Microsoft Excel Spreadsheet (v15). Due to the way each collision was recorded it was necessary to cross reference two separate databases to be able to manually enter a more detailed description of what had occurred. The basic information initially showed the internal reference number of the incident, date, vehicle registration number, officer collar number and a very brief description.

***Stage 2:***

To establish more detailed vehicle information, each registration number identified above, was entered into a separate Police Fleet vehicle database to establish vehicle make and model, and if it was a marked, unmarked or hire vehicle. This information was added to the initial spreadsheet.

***Stage 3:***

The research data spreadsheet contained details of the vehicle registration number, time and exact location of the collision and Officer's collar number. The recording of the collar number implied that the driver was unidentifiable to the researcher but was still trackable for data collection.

The final spreadsheet, Table 5.1, contained the following data cells:

Collision date
Brief description at the time of reporting.
Location
Summary Cause
Registration number
Make and Model of the vehicle
Marked / Unmarked
Time of the incident
Collar number of drivers
Headlights Flashing on / off / not known
Sirens on / off / not known
Blue Lights on / off / not known

**Table 5.1: Information categories collected from Police databases**

Each time the vehicle was used, the driver logged the magnetic "IR3+" key into the system which was registered against the individual for identification. This provided traceability in the event of an incident/relevant event. By later accessing the "IR3+" system it was possible for the researcher to locate each vehicle which had

subsequently been involved in a collision. The Officer's collar number, location and time of the incident previously gathered also allowed cross referencing to ensure the correct time frame was reviewed. This information was then used to determine which vehicles were displaying "blue lights", sirens and flashing headlights at the exact time or during the last 15 seconds prior to the collision occurring.

The study used quantitative analysis and crosstabulations (Robson, p431) to determine the effect markings on Police vehicles had on collisions. This method allows analysis of the relationship between two categorical variables to identify trends. A qualitative analysis using software (NVivo) was also applied to the fleet report text to try to establish if the research questions could be further addressed. This software ensured that an investigation of common themes could be carried out removing researcher bias through independent thematic coding analysis. The identified themes would subsequently allow for further interpretation in conjunction with the quantitative data (Robson, p467).

#### **5.4 Data selection**

Data collection yielded a total 1,677 collisions during the period from 15<sup>th</sup> December 2010 to 30<sup>th</sup> June 2015. Prior to this date the "IR3+" system was not fitted as standard into every vehicle within the Force, so it was therefore not deemed relevant to examine collisions prior to this timeframe. RQ4 investigated the effect of emergency warning systems on collision liability and required data gathered on the use of blue lights, flashing headlights or sirens which was only available from 15<sup>th</sup> December 2010.

Using Microsoft Excel (v15, 2013) the sort function could distinguish marked vehicles, unmarked vehicles and type not known / hire car. There were 1,262 collisions involving a marked Police vehicle, and 358 unmarked Police vehicle collisions (Table 5.2). Collisions where the vehicle was hired, or the type had not been noted accounted for an additional 57 collisions and these were discounted from further analysis. The reason for discarding the cases was that the vehicles were not fitted with IR3+ or any emergency warning system and as such no data could be extracted regarding their operational usage.

Marked and unmarked vehicle collisions were sub analysed within Microsoft Excel to establish frequency of causation factor and the results can be seen in Table 5.2.

All causation classifications for the database were determined by key personnel within the Fleet department responsible for maintaining the records and as such no reclassification occurred. Table 5.2 shows the varying types of collisions and illustrates that third-party collisions accounted for 26% of all collisions involving a marked vehicle, and 38% for an unmarked vehicle without consideration for liability.

The two causation factors investigated further for this study were those labelled “Hit 3<sup>rd</sup> Party” and “Hit by 3<sup>rd</sup> Party” for which liability had already been determined by an investigating officer at the time of the event. The remaining collisions whilst shown to illustrate the context of the type of collisions within the Force, were discounted as they were deemed as falling outside the research aims and were therefore considered to be beyond the scope of this research.

Causation	Marked (n)	Marked %	Unmarked (n)	Unmarked %
<b>Hit stationary object</b>	435	34.5	124	34.6
<b>Hit by 3<sup>rd</sup> Party</b>	<b>176</b>	<b>13.9</b>	<b>97</b>	<b>27.1</b>
<b>Cause unknown</b>	167	13.2	53	14.8
<b>Hit 3<sup>rd</sup> Party</b>	<b>153</b>	<b>12.1</b>	<b>39</b>	<b>10.9</b>
<b>Hit Parked vehicle</b>	136	10.8	15	4.2
<b>Criminal damage</b>	125	9.9	11	3.1
<b>Hit Debris</b>	23	1.8	11	3.1
<b>No damage</b>	19	1.5	2	0.6
<b>Weather conditions</b>	9	0.7	1	0.3
<b>Vehicle failure</b>	7	0.6	0	0
<b>Minor / Misc.</b>	7	0.6	3	0.7
<b>Collision with an animal</b>	5	0.4	2	0.6
	<b>1,262</b>	<b>100%</b>	<b>358</b>	<b>100%</b>

Table 5.2: Police vehicle collisions by causation and vehicle marking

An initial crosstabulation of cases, which related to driver liability, labelled only as “hit by third party” and “hit third party” showed a statistical significance ( $n = 465$ ,  $\chi^2(1) = 12.616$ ,  $p < 0.001$ ) and these were investigated in greater detail. Other causation factors were disregarded as they fell outside of the research scope.

## 5.5 Liability

All Police collisions are investigated by the Police drivers’ senior officer and assessed for liability or culpability. A Police collision report, known as a POLAC is then written in line with Force guidance. A blank POLAC form can be found in Appendix 10.

The senior officer considers the scene, establishes feedback from all parties and on balance makes a judgement based on the evidence. The report details the situational information such as location, time, vehicle, and driver details alongside a summary of the assessed causation. Where this liability was already determined, no reallocation of cases occurred, for the purposes of this study.

### 5.5.1 Unmarked Police vehicle collisions

Police vehicles which were unmarked and were involved in a collision with a third party, regardless of liability, totalled 136 during the sampling time frame (Table 5.3). Research questions 2, 3 and 4 were all considered under the emergency response driving condition. Therefore, from the original 136 unmarked collisions, those where an emergency response was not believed to have taken place were extracted thereby reducing the dataset to 33 (Table 5.3).

	“Emergency”	“Non-emergency”	Total
<b>Hit 3<sup>rd</sup> Party</b>	11	28	39
<b>Hit by 3<sup>rd</sup> Party</b>	22	75	97
	33	103	136

**Table 5.3: Unmarked vehicle collisions by liability and response type**

In this study, to establish if an emergency response had occurred, the Fleet description of the incident was reviewed alongside the categorisation by the Fleet manager.

Langham et al. (2002) observed that, in his study involving only marked Police vehicles, collisions caused by a third party were uncommon, and as such, a small data set followed. Whilst this resulted in research difficulties it enabled Langham et al. (2002) to make observations from actual reports of why members of the public may hit stationary and highly liveried Police vehicles.

### 5.5.2 Marked Police vehicle collisions

There were 329 cases (Table 5.4), in which the marked Police vehicle was initially considered to have been involved in a third-party collision. Again, through analysis of the Fleet department report 148 cases were identified as collisions where an emergency response (Grade 1 or 2) was believed to have been in progress. The remaining 181 cases, deemed non-emergency driving events, were discarded for the purposes of the study.

	“Emergency”	“Non-emergency”	Total
<b>Hit 3<sup>rd</sup> Party</b>	82	71	153
<b>Hit by 3<sup>rd</sup> Party</b>	66	110	176
	148	181	329

Table 5.4: Marked Police vehicle collisions by causation and response

Where the emergency response was known not to have occurred, reported collisions extracted from the Fleet reports involved such events as:

*Officer heading towards.... road when a vehicle ahead slowed to turn and unexpectedly stopped mid junction, vehicle in front of officer also stopped and officer failed to react and collided with vehicle in front*

*Both drivers passed each other within a narrow section of the highway, and both failed to take into account large door mirrors*

*Officer sighted area of burnt land so decide to reverse and explore location but due to limited rear visibility did not notice the vehicle behind*

A quantitative analysis was used to establish any correlation between the use of the vehicle warning system and the type and frequency of resulting collisions. A qualitative analysis was also conducted to identify any commonality between collisions and vehicle type. Permission was requested to access the POLAC report for each of the collisions to try to establish if further information on the liability was available.

To establish how many Grade 1 and 2 calls the Force responded to, a Freedom of Information request was submitted to South Wales Police. The response (Appendix 11) showed that on average they respond to 7,761 per month for Grade 1 type. The number of collisions which involved a third party, regardless of liability, over the data time frame (December 2010 to June 2015) totalled 33 for unmarked Police vehicles (Table 5.3) and 148 for a marked Police vehicle (Table 5.4). The combined 181 collisions equate to 3.3 collisions per annum which is 0.004% of all collisions that were recorded.

## **5.6 Participants**

All Police drivers who had permission to drive a Force vehicle were aware that the vehicle was fitted with an in-vehicle data recorder (IVDR). Permission was not required from any individual in respect of accessing the vehicle tracking data as overall permission had been received from a Senior Officer at the start of the study in addition to the full ethics approval received (Appendix 1).

As the vehicles used in this study were held within the Roads Policing function all drivers were trained to an Advanced Police level of driving, as defined by the College of Policing (College of Policing<sup>14</sup>).

## **5.7 Results**

A review of collisions, by vehicle marking type, was conducted to try to establish if the markings affected the number of multiple collisions a vehicle may have been involved

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<sup>14</sup> College of Policing *Driver/rider levels and vehicle categories* [Online] <https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/?s=high+performance+vehicles>

in. The original extraction of data from the Fleet department included the officer collar number providing a unique reference for each collision whilst preventing driver identification. By using the collisions, with an attached reference only, it was possible to establish if some officers were involved in single or multiple collisions, and whether this varied between vehicle marking type. Collisions where there was no recorded collar number were discarded for this specific analysis as officer collision frequency was not possible on these cases due to lack of traceability. The analysis aimed to provide additional corroboration to the possible risks of driving a specifically marked Police vehicle.

### *5.7.1 Unmarked vehicle collision frequency by Officer*

An analysis of collisions, involving an unmarked Police vehicle that occurred over the data time frame, totalled 358 with a variety of causation factors as previously shown in Table 5.2.

Of the 358 collisions, 68 did not have an associated collar number recorded and these records were discarded for this analysis. This was due to being unable to trace the driver's collision history through any Police database. A review of the collar numbers identified 26 drivers (10%) who had been involved in multiple collisions regardless of cause or response type. A further 232 drivers (90%) had been involved in a single collision as shown in Table 5.5.

	1 Collision	2 Collisions	3 Collisions	4 Collisions	Unknown	Total
Number of Officers	232	21	4	1	68	326
% of identified collisions	90	8	1	1	n/a	100%
No of collisions	232	42	12	4	68	358

**Table 5.5: Collision frequency for Police Officers in an unmarked vehicle**

The multiple collision analysis that occurred in an unmarked Police vehicle for identified officers showed that 90% of collisions analysed involved an officer having a single collision only within the time frame. The remaining 10% of officers went on to have multiple collisions of between 2 and 4 in number.

### *5.7.2 Marked vehicle collision frequency by Officer*

An identical review was undertaken for marked Police vehicles and the original analysis of data found 1,262 collisions regardless of cause or liability (Table 5.2). In the case of marked collisions, the collar numbers for 259 drivers were not available within the data records and therefore these cases were excluded for the purposes of this analysis. This left a total of 1,003 collisions where the drivers' collision frequency was reviewed.

Collar numbers were again used only as a reference to identify an officer for data tracking.

	1 collision	2 collisions	3 collisions	4 collisions	5 collisions	6 collisions	Unknown	Total
Number of officers	499	166	36	13	0	2	259	975
% of identified collisions	70	23	5	2	0	0	n/a	100%
No of collisions	499	332	108	52	0	12	259	1,262

**Table 5.6: Collision frequency for Police Officers in a marked vehicle**

Table 5.6 shows that for a marked Police vehicle, 30% of officers had been involved in multiple collisions with two officers having been involved in 6 collisions in a marked vehicle. These results contrast with an unmarked Police vehicle (Table 5.5) where just 10% of Officers had been involved in 2 or more collisions.

A review of the collision frequency of Police drivers between the two different types of vehicle types shows that those driving a marked vehicle appeared to be involved in multiple collisions more frequently than those in an unmarked vehicle (Table 5.5 and Table 5.6) although not examined statistically.

### **5.7.3 Freedom of Information (FOI) request**

To establish a picture of emergency response for marked and unmarked Police vehicle collisions a Freedom of Information (FOI) was submitted to the 43 UK Police Forces. They were asked to respond to “Between 2011 and 2014, whilst responding to an emergency, how many collisions occurred that:

- a. Were in a marked Police vehicle which hit a 3<sup>rd</sup> party
- b. Were in a marked Police vehicle which was hit by a 3<sup>rd</sup> party
- c. Were in an unmarked Police vehicle which hit a 3<sup>rd</sup> party
- d. Were in an unmarked Police vehicle which was hit by a 3<sup>rd</sup> party”

Of the 43 requests to each of the UK Police Forces, 23 Forces were unable to provide the required answers as the data was held in such a way that the cost of extracting it became prohibitive and therefore exempt for disclosure under UK Legislation (Freedom of Information Act, 2000). A further two Forces (Merseyside and Sussex) did not respond to the request. A summary of the response for each Force can be found in Appendix 12.

For those Police Forces who could provide the information, a visual inspection of the data did not show consistent patterns of liability. From data collected at South Wales Police the number of marked vehicle collisions whereby liability was on the part of the Police driver was lower than that where liability was on the part of the third party (Table 5.3). This was also found to be the case for unmarked Police vehicle collisions where third-party liability collisions were higher (Table 5.4)

Of the Forces who responded to the questions in full, 5 out of 12 (Bedfordshire, Dyfed Powys, Humberside, Staffordshire, Thames Valley) found that a marked Police vehicle was more likely to be struck when the third party was found to be blameworthy than

one where the Police driver was at fault which is consistent with the results found for South Wales Police.

For unmarked Police vehicles, 6 out of 12 (Cumbria, Hampshire, Northumbria, Staffordshire, Thames Valley, Warwickshire) responding Forces reported that an unmarked vehicle was more likely to be struck by a third party than be involved in a blameworthy collision themselves. This is consistent with other findings in this chapter.

**RQ4:** Is liability of collision dependent on whether the Police emergency response vehicle is marked or unmarked?

An extraction of the cases where an emergency response was suspected or known to be in place at the time of the collision resulted in 181 cases as shown in Table 5.7. A comparison of the collisions that involved a Police driver hitting a third party or being hit by a third party, whilst on response were analysed against vehicle markings.

	Liability		Total
	Hit 3 <sup>rd</sup> Party	Hit by 3 <sup>rd</sup> Party	
Markings	Marked	Unmarked	
Marked	82	66	148
Unmarked	11	22	33
Total	93	88	181

**Table 5.7: Crosstabulation to test for association between vehicle markings and liability.**

The Pearson Chi-Square Test was used to test for any overall association between vehicle markings and liability and the results were statistically significant ( $n = 181$ ,  $\chi^2(1) = 5.262$ ,  $p=0.022$ ). This analysis suggested that a marked vehicle was more likely to hit a third party with a 24% increase compared to being hit by a third party. However, for an unmarked vehicle the opposing effect on liability was seen with the Police vehicle being twice as likely to be hit by the third party compared with hitting the third party. This difference in liability is investigated further with consideration of both liability and marking type within this chapter.

The detail extracted from the fleet department for the 181 cases can be found in Appendix 13 and 14.

### 5.7.4 Hit third party

#### *Unmarked*

Using NVivo 11 (QSR International, 2015) a review was conducted of the cases to identify primary themes which may indicate why markings influenced the collision. To avoid any researcher bias on the small volume of text available, the programme auto-coded themes. For collisions where the unmarked Police vehicle hit a third party the thematic review identified 2 primary categories and 3 subthemes in Table 5.8.

Primary category	Subtheme	Coding frequency
Traffic	Traffic Lights	1
	Road Traffic Collision	1
Negotiating roundabout	Negotiating roundabout	2

Table 5.8: NVivo thematic analysis by volume – Unmarked car hit a third party

The text which was identified within the thematic analysis are itemised below.

#### Negotiating roundabout

*“Both Vehicle were **negotiating roundabout** when both vehicles collided.”*

*“Cyclist in process of **negotiating roundabout** and indicated to turn right when Police vehicle entered the roundabout and hit the cyclist. “*

#### Traffic

*“As officer approached junction of Waterloo road the **traffic lights** were on red against him.”*

*“Officer responding to **road traffic collision**, Blues and Two’s displayed”*

The item marked red has also been identified as a subtheme for a marked vehicle which hit a third party. A diagrammatic hierarchy chart, as generated by NVivo, showing the subcategory proportionality can be found in Appendix 15.

Due to there being just 11 cases with limited text volume no direct conclusions could be drawn at this stage. A review of Police liability marked vehicle collisions has also been conducted providing a comparison.

### *Marked*

A Chi-square test of Association between vehicle markings and liability from Table 5.7, found there was a statistical significance which suggested that the vehicle type did in some way, influence collision liability. This is considered later in this chapter, alongside a comparison with the results from the unmarked vehicle collisions analysed above.

To further investigate the reasons for this, a thematic analysis using NVivo 11 was conducted for the fleet report details from marked vehicles which hit a third party. Primary categorisations are shown in Table 5.9 and illustrate many more themes than were identified for the unmarked vehicles. This could be explained through the larger volume of data analysed (82 cases) and the possibility that marked vehicles are used for a wider range of operational needs.

Primary category	Subtheme	Coding frequency
Officer	witnesses	1
	stationary	1
	states	1
	overtook	1
	attempts	1
	enroute	1
Vehicle	suspect	1
	stationary	1
	several	1
	2nd	1

	approached	1
	Struck offside	1
Offside	Offside bend	1
	Clipped offside	1
	response	2
Response	immediate	1
	emergency	1
	Wrong	2
Side	Near	1
	incorrect	1
Party	Injured	2
	3rd	2
Call	Response	2
	emergency	1
	Response	1
Emergency	Equipment	1
	call	1
	Vehicle	1
Stationary	Cars	1
	officer	1
Lights	Approaching traffic lights	1
	Approaching lights	1
Traffic	Slow	1
	Approaching traffic lights	1
Wing Mirror	wing mirrors	2
Wrong side	Wrong side	2

**Table 5.9: NVivo thematic analysis by volume - Marked car hit a third party**

The themes highlighted in red could also be found in the thematic analysis for unmarked vehicle with the same collision liability, namely traffic and traffic lights.

The subcategory proportions for the identified Primary themes as shown in the hierarchy chart generated by NVivo can be found in Appendix 15. The identified reference from the text for marked vehicle collisions detailed below.

Traffic

*“Officer travelling west en-route to an immediate response, travelling along wrong side of road to overtake **slow traffic** and misjudged position of 3rd party”*

*“Officer approaching **traffic lights** on G1 where member of the public was stationary”*

For collisions where an unmarked Police vehicle hit a third party the thematic analysis identified traffic and negotiating roundabouts (Table 5.8). A comparison to the marked vehicles where liability is also apportioned to the Police vehicle showed there was just one common theme between the marking types identified as “traffic lights” and highlighted above in Table 5.9. For an unmarked vehicle these subthemes totalled 1 out of a total 4 (25%) identified, whilst for the marked vehicle they accounted for just 3 out of a total 43 (6.7%).

A thematic relationship chart for “hit a third party” collisions can be found in Figure 5.8.

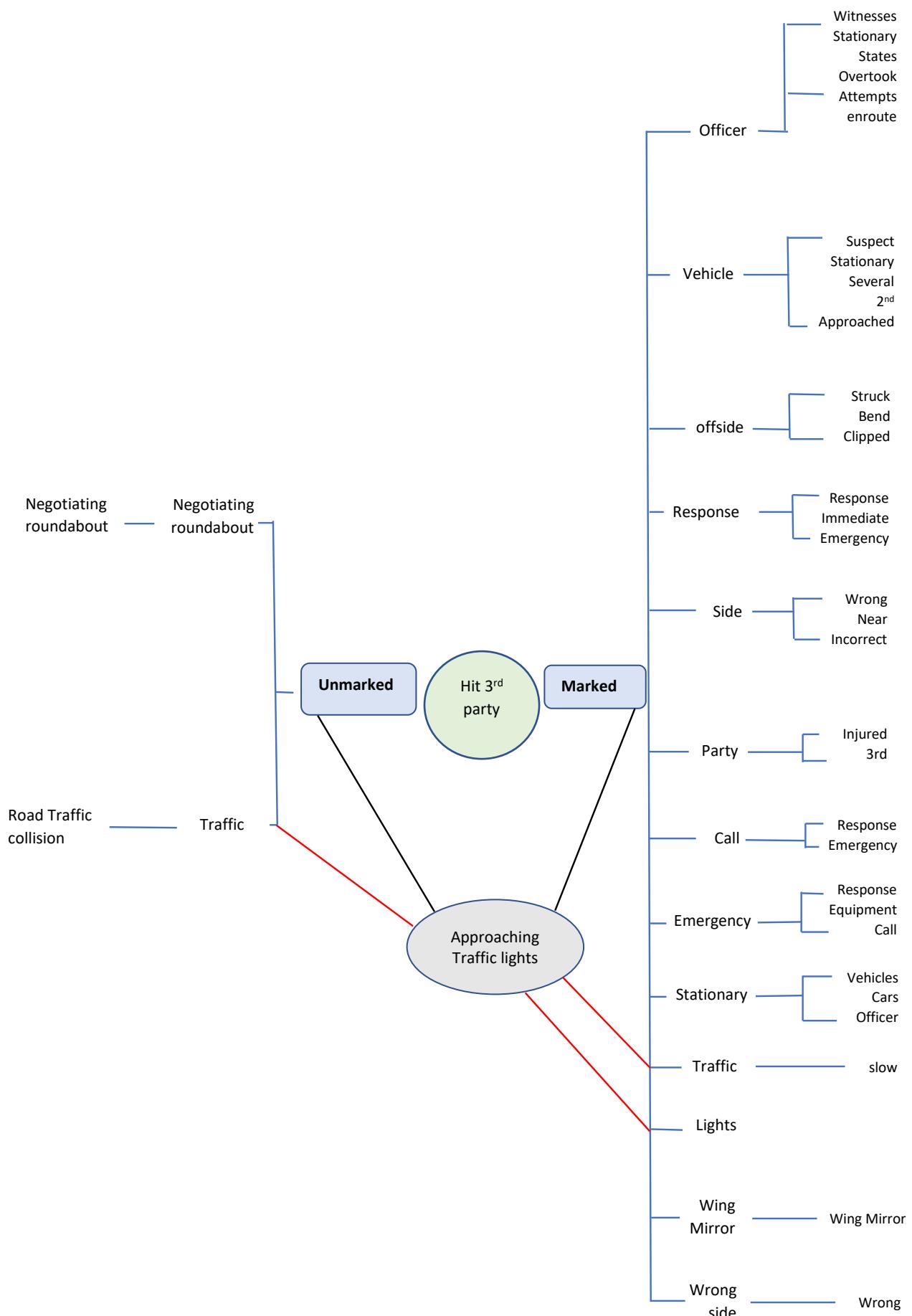


Figure 5.8: Thematic Analysis "Hit third Party"

### 5.7.5 Hit by third party

#### *Unmarked*

In order to investigate whether there was any commonality amongst cases a thematic analysis was also conducted for the “hit by 3<sup>rd</sup> party” events in relation to unmarked vehicles.

Whilst an inspection of the fleet report was possible, the 22 cases were analysed using software designed to provide a thematic analysis of the text and greater inter-rater reliability. NVivo version 11 (QSR International 2015) was applied to the text from the fleet report for unmarked vehicles and the program allowed to automatically code for identified themes. This was considered appropriate due to the small volume of text.

The thematic analysis by volume can be seen in Table 5.10 showed that only one primary category was identified through the coding being “Vehicles” where an unmarked car was hit by a third party. Ten subthemes were identified within the broader categorisation. For the 22 original fleet cases for the unmarked vehicle “suspect”, “overtaking” “Police” and “offending” vehicles have been identified within the text and this may be due to the operational nature of the vehicle, alongside “covert” and “unmarked”.

Primary category	Subtheme	Coding frequency
Vehicle	Suspect	2
	Police	2
	Unmarked	1
	Overtaking	1
	Offending	1
	Marked	1
	Heavy goods	1
	Covert	1
	Causing	1
	2 overtook	1

Table 5.10: NVivo thematic analysis by volume – Unmarked car hit by a third party

The themes in red have commonality with those of a marked vehicle having the same liability and will be further examined later in this chapter. The NVivo hierarchy chart showing the diagrammatic proportions of identified subcategory themes, for unmarked vehicles hit by a third party within the primary theme of “Vehicle” can be found in Appendix 15.

Suspect vehicle

*“Covert vehicle involved in pre-emptive TPAC Manoeuvre on **suspect** vehicle when subject was seen to panic and swerved hitting Police vehicle.”*

*“**Suspect** vehicle reversed and collided.”*

Overtaking

*“**Vehicle 2** overtook vehicle 1 and collision occurred.”*

*“Police vehicle travelling in Lane 3, vehicle 2 **overtaking vehicle 1**”*

Offending Vehicle

*“Whilst going around the roundabout the **offending** vehicle entered into lane and came into contact with Police vehicle.”*

For reference a TPAC manoeuvre (Tactical Pursuit and Containment) is an option available to the Police when forcing a suspect vehicle to stop by utilising a number of high performance Roads Policing vehicles to box in the suspect and as such forcing them to slow down in a controlled manner. The themes which appear to relate to the operational nature of the vehicle are shown below where the report has been extracted from the Fleet record.

Covert vehicle

***“Covert vehicle involved in pre-emptive TPAC Manoeuvre”***

Unmarked vehicle

***“Officer in unmarked Police vehicle assisting other officers”***

At this stage for “covert” and “unmarked” sub themes it is not possible to gain further insight as to whether the markings influenced the collisions. The remaining fleet report items identified within the thematic analysis can be found in Appendix 13 and the subcategory themes highlighted within the Fleet text.

Whilst blame was apportioned by the Police it was not possible to fully investigate collision details further and establish more specific causation factors as the information recorded was extremely limited. Due to changes in Police data archiving methods the researcher could not gain access to the POLAC reports in most cases.

*Marked*

The thematic analysis for marked Police vehicles (Table 5.11) which were hit by a third party showed a higher number of themes than for the unmarked equivalent (Table 5.10). This could be expected due to the larger data set.

Primary category	Subtheme	Coding frequency
Vehicle	Suspect	2
	Offending	2
	Overtaking	2
	Stationary	1
	Path	1
	Head	1
	Unknown	1
	Unattended	1
	Suspicious	1
	Protecting	1
	Positioned	1
	Oncoming	1
	Saw	2
	Realising	1
	Overtook	1
	Decamped	1
	Abandoned	1
	Moving	1
	2 Police	1
Lane	Wrong	1
	Single	1
	Nearside	1
	Entered	1
	bus	1
Car	Stationary	1
	Patrol	1
	Garage car park	1
	2 Police	1
	2nd	1

**Table 5.11: NVivo analysis of “Themes” by volume - Marked Vehicles hit by a third party.**

As with the unmarked vehicles which were hit by a third party the most common broad theme was “vehicle”. Many of the themes within that are related to the operation of the vehicle such as:

Suspect vehicle

*“Officer following **suspect vehicle** when it stopped outside an address”*

*“The driver alighted and in doing so **the suspect vehicle** rolled back and collided with the Police vehicle”*

Offending vehicle

*“Officer in ongoing pursuit, **offending vehicle** overtook a line of traffic crossing over into oncoming traffic”*

*“Police vehicle was then struck by towed trailer of **offending vehicle**”*

Overtaking vehicle

*“RP states Police vehicle with emergency lighting travelled around the bend at 50mph **overtaking vehicles**”*

*“As officer **overtook vehicle** it decided to turn right across the Police vehicle path.”*

*“Officer responding to Alpha 1, **overtaking vehicles**, the collision involved oncoming vehicles.”*

A summary of all the identified cases can be found in Appendix 14. The NVivo generated diagram which identified the proportion of subcategories found in the primary themes of vehicle, car and lane can be found in Appendix 15. A comparison between the unmarked and marked vehicles which were hit by a third party for any thematic commonality showed that for both vehicle types “suspect”, “offending” and “overtaking” were identified across both. For an unmarked vehicle this accounted for 7 out of 12 cases (58.3%), whereby for a marked vehicle it accounted for 8 out of 36 sub themes (22.2%). The three sub themes can be attributed to the occupational demands of the vehicle and do not suggest at this stage that the physical markings caused any adverse effect.

The diagrammatic relationship between vehicle marking and the primary or sub themes can be found in Figure 5.9 which shows the common themes between vehicle type where liability was considered the same.

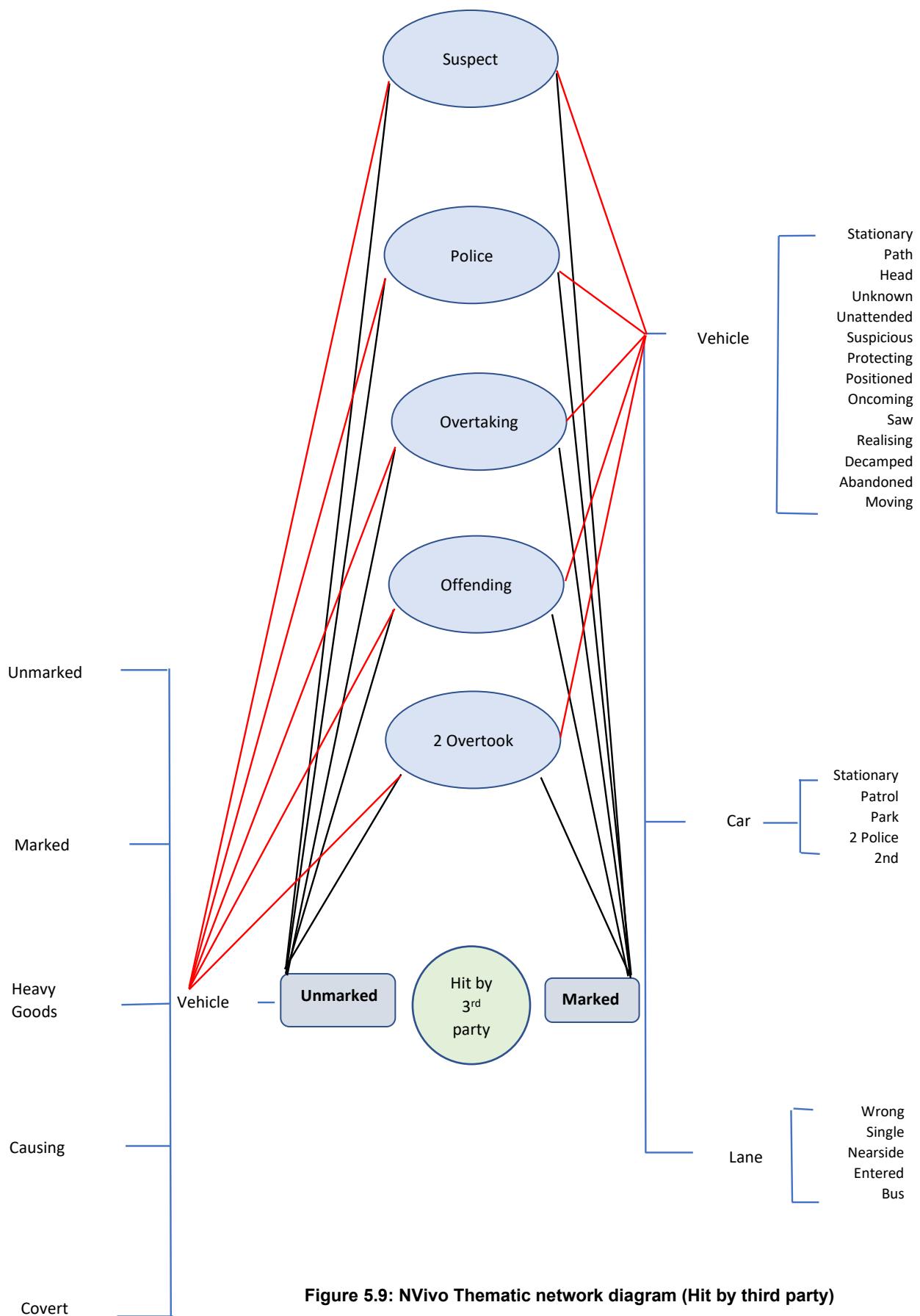


Figure 5.9: NVivo Thematic network diagram (Hit by third party)

There was a statistically significant difference identified between the vehicle markings and the number of collisions that occurred, but the reason could not be identified through a thematic analysis. However, this could be explained by the small data set for the unmarked vehicles.

A summary of the faults showed that, for the items that were identified as primary themes for a marked vehicle, they related to the operational role of the vehicle – vehicle, traffic lights, officer, response, party, call, emergency, stationary and lights. However, some of the themes related to the specific damage that had been caused to the vehicles themselves through probable positioning errors. Table 5.12 below shows what positioning faults through thematic analysis were identified for each vehicle type according to liability and a summary of all text can be found in Appendix 13 and 14. Positioning faults were extracted by NVivo and all were where a marked Police vehicle had hit either a wing mirror or the near side of a third party vehicle.

	<b>Hit third party</b>	<b>Hit by third party</b>
<b>Unmarked</b>	None	None
<b>Marked</b>	<u>Wing mirrors x 2</u> On G1. He misjudged the position of another car and wing mirrors collided. (H/lights only on) ----- Responding to G1 along dual carriageway during rush hour and was attempting to filter, in doing so wing mirror collided with stationary vehicle. (H/lights and B/lights on)  <u>Near side x 1</u> Member of the public exited roundabout to near side to allow the Police to make progress. At point of collision width of the road was restricted, Police vehicle clipped offside of member of the public's vehicle. (B/lights and sirens on)	None

**Table 5.12: Summary of NVivo by positioning fault**

**RQ5:** Is the frequency of collisions between marked and unmarked Police emergency response vehicles and civilian vehicles dependent on time of day?

Due to the small data size for unmarked vehicles it was considered inappropriate to use one hour time blocks and therefore the time was chunked into 4 equal blocks of 6 hours which mirrored research by Kahn et al. (2001) who investigated Ambulance collisions. In relation to the research question, analysis examined the existence of an association or trend.

### 5.7.6 Hit third party

A crosstabulation (Table 5.13) was applied to the cases where the vehicle was known to have hit a third party.

		Markings		<b>Total</b>
		<b>Marked</b>	<b>Unmarked</b>	
<b>Time</b>	00:00 to 05:59	10 (12%)	2 (18%)	12
	06:00 to 11:59	19 (23%)	3 (27%)	22
	12:00 to 17:59	34 (42%)	4 (37%)	38
	18:00 to 23:59	19 (23%)	2 (18%)	21
	Total	<b>82</b>	<b>11</b>	<b>93</b>

**Table 5.13: Crosstabulation of time compared to vehicle markings (Hit 3<sup>rd</sup> Party)**

A crosstabulation of the data for the events (Table 5.13) whereby the Police vehicle was deemed liable showed no noticeable difference between the time slots and the vehicle markings.

The Pearson Chi-Square test for Association also showed that the results were not statistically significant ( $n = 93$ ,  $\chi^2(3) = 0.507$ ,  $p=0.917$ ).

It is not possible to say with confidence whether there was any association between the time slots and the vehicle marking type and there does not appear to be any substantial differences in the distribution of incidents across the time chunks.

### 5.7.7 Hit by third party

A crosstabulation (Table 5.14) was also applied to the cases where the vehicle was known to have been hit by a third party.

		Markings		
		Marked	Unmarked	Total
Time	00:00 to 05:59	15 (23%)	1 (5%)	16
	06:00 to 11:59	11 (17%)	6 (27%)	17
	12:00 to 17:59	24 (36%)	11 (50%)	35
	18:00 to 23:59	16 (24%)	4 (18%)	20
	Total	66	22	88

Table 5.14: Crosstabulation of time compared to vehicle markings (Hit by 3<sup>rd</sup> Party)

The Pearson Chi-Square test for Association showed that the results were not statistically significant ( $n = 88$ ,  $\chi^2(3) = 4.999$ ,  $p=0.172$ ). The significance level may be due to the small data size for unmarked vehicles. A visual inspection shows a large difference for the time of 00:00 to 05:59 which was investigated further below in relation to the marking types.

#### *Unmarked Vehicles*

Date	Time	Initial Fleet Detail
15th December	03:40	Officer waiting at Traffic lights behind <b>offending vehicle</b> when he reversed and hit Police vehicle. Driver arrested and breathalysed.

Table 5.15: Unmarked Police vehicle collision between 00:00 and 05:59

## Marked Vehicles

	Time	Initial Fleet Detail
12 <sup>th</sup> February	00.20	Officer observing <b>suspects</b> who got into vehicle, suspects drive off, Police vehicle stopped behind them and suspects reversed into Police vehicle.
4 <sup>th</sup> June	02.09	Officer in short pursuit where <b>subjects decamped</b> vehicle and it started to roll. Officers positioned their vehicle to prevent it rolling further down the hill.
19 <sup>th</sup> November	00.33	Member of the public failed to stop for officers and officers then carried out <b>a tactical manoeuvre</b> to bring the pursuit to a safe conclusion.
13 <sup>th</sup> March	03.20	Officer attended to reports of a suspicious vehicle and drove towards the subject. Unknown driver attempted to drive around the Police vehicle but reversed and <b>rammed it 4 times</b> .
23 <sup>rd</sup> March	02.30	Fiesta reversed in an attempt to <b>evade the Police</b> and collided with the front of the patrol car.
8 <sup>th</sup> August	03.40	Officer going through the traffic lights in sequence when a Taxi came from the nearside and collided.
1 <sup>st</sup> September	02.20	Officer following suspect vehicle when it stopped outside an address. The driver alighted and in doing so the <b>suspect vehicle</b> rolled back and collided with the Police vehicle.
19 <sup>th</sup> January	00.30	As 2 Police vehicles responded to an emergency an intoxicated pedestrian ran out into the side of the first Police vehicle. As a result, the vehicle performed an emergency stop and vehicle 2 collided with the rear.
16 <sup>th</sup> June	01.12	Officer in response to drunk driver, <b>suspect</b> appeared from a blind right hand bend on wrong side and hit the Police vehicle head on.
27 <sup>th</sup> February	05.55	Member of public collided with the central reservation. Officer signalled to stop. <b>Pursuit authorised</b> . Hit reservation then Police vehicle.
10 <sup>th</sup> January	02:52	Vehicle <b>failed to stop</b>
1 <sup>st</sup> October	03.30	Officers attending an incident saw vehicle being driven at speed in a dead end. He did a handbrake turn and <b>sped directly at the Police</b> colliding with the nearside wing and hit 2 Police cars.
11 <sup>th</sup> March	01.34	After short follow of what was an <b>OSSV</b> , driver abandoned vehicle on an uphill gradient. Vehicle rolled back and made a glancing contact with the Police vehicle.

No date	04.42	At conclusion of a <b>tactical pursuit</b> the subject vehicle was cornered in a cul de sac. Driver attempted to get past but made contact on the vehicle.
1 <sup>st</sup> February	00.55	Officer in <b>authorised pursuit</b> with subject vehicle which collided lightly with parked and unattended vehicle. Subject vehicle continued taking the roundabout on the wrong side. Police Vehicle damage.

**Table 5.16: Marked Police vehicle collisions between 00:00 and 05:59**

For the unmarked vehicle, the damage to the Police vehicle was caused by a suspected criminal vehicle as highlighted (Table 5.15). For the marked vehicle cases (Table 5.16) which occurred between Midnight and 05:59, 9 related directly to Police duties and the apprehension of a suspect vehicle (highlighted in yellow in Table 5.16) and a further 4 cases (highlighted in green – Table 5.16) in which damage occurred involved a Police tactical manoeuvre or pursuit. A further two events were non-specific in relation to any potential trend. It is not possible to say that the time of day influenced the proportion of collisions in relation to markings. However, the data suggest that collision type is influenced by specific time of day, in this case, 00:00 to 05:59 but only due to the operational nature of policing and the fact that crime may occur more during the hours of darkness. This is considered in the discussion.

**RQ6:** Does the operation of the Police vehicle emergency warning systems (unmarked vehicle) affect the collision liability?

### 5.7.8 Emergency vehicle warning systems - Unmarked

The data, of 33 emergency response collisions, was analysed using SPSS and cases where the IVDR system was not working or not available were removed. This left 18 remaining cases where the state of the emergency warning systems could be verified, namely flashing headlights, “blue lights” and sirens were on or off.

#### *Headlights*

The 18 cases (Table 5.17) resulted in only 3 cases identified where headlights were on at the time, or just prior to the incidents and the remaining 15 were confirmed as

not using flashing headlights. All three cases whereby the flashing headlights were operating resulted in the Police vehicle being hit by a third party.

		Liability		Total
		Hit 3 <sup>rd</sup> Party	Hit by 3 <sup>rd</sup> Party	
Headlights	On	0	3	3
	Off	8	7	15
	Total	8	10	18

**Table 5.17: Crosstabulation to Test for Association between flashing headlights and liability.**

A test for Association was conducted between liability and headlights (Table 5.17), known to be in use at the time or immediately prior to the incident. The results were not statistically significant as assessed by Fisher's Exact test ( $p= 0.216$ ).

The 15 cases where it was known the headlights were not flashing, as gathered from the IVDR, showed no statistical difference in the liability of collisions that would occur as in this data eight cases resulted in the Police driver hitting a third Party whilst seven were the fault of the civilian driver.

Date	Time	Initial Fleet Detail
22nd May	12:55	Officer in pursuit, vehicle failed to stop and intentionally reversed at speed and its rear end collided with front of officer's vehicle.
13th June	11:50	Police vehicle attended a road traffic collision, also in attendance West Wales Fire Service who positioned tender directly behind Police vehicle. Once incident dealt with Fire Officer prepared to move off but rolled into Police Vehicle.
30th July	21:20	Covert vehicle involved in pre-emptive TPAC Manoeuvre on suspect vehicle when subject was seen to panic and swerved hitting Police vehicle.

**Table 5.18: Hit by a 3<sup>rd</sup> party - flashing headlights were operational (unmarked)**

The three incidents of the Police vehicle, using flashing headlights, immediately prior to or at the time of the collision whereby the Police vehicle was struck by a third party are detailed in Table 5.18. Two of the three occurred whilst the vehicle was involved

in operational driving such as a pursuit or TPAC (Tactical Pursuit and Containment) manoeuvre and resulted in a collision caused by a deliberate third party violation. The third incident (13<sup>th</sup> June) involved a Fire Appliance moving away and investigation of the POLAC report details only “*Once the RTC was dealt with the fire officer has prepared to move off, in doing so he inadvertently rolled forward*”. This appears to be due to a minor driver error, but it was not possible to be more precise from the information gathered and without the opportunity to interview the Fire Appliance driver. There was no further information to identify who the driver was.

### **“Blue Lights”**

As with the review of the flashing headlights the extraction of cases where the IVDR was not working or fitted resulted in a remaining data size of 18 as shown in Table 5.19. When the fitted “blue lights”, were operating 4 cases resulted in a collision from a third party with no cases the fault of the Police driver. This is a similar trend to the previous results of the headlights.

		<b>Liability</b>		<b>Total</b>
		<b>Hit 3<sup>rd</sup> Party</b>	<b>Hit by 3<sup>rd</sup> Party</b>	
<b>Blue Lights</b>	On	0	4	4
	Off	8	6	14
	Total	8	10	18

**Table 5.19: Proportion of collisions where the “Blue Lights” were known to be available for operation.**

The Fisher’s Exact test showed that the results were not statistically significant ( $p=0.092$ ).

An analysis of the four incidents in Table 5.20 showed that three were the same events as those where headlights were additionally being used with the remaining collision on the 6<sup>th</sup> May the result of an operational tactic known as TPAC (Tactical Pursuit and Containment). As with the use of the headlights the resulting collisions, in all but one case, cannot be attributed to errors such as distractions or driver mistakes but because of deliberate acts or violations in respect of UK driving legislation.

Date	Time	Initial Fleet Detail
6th May	22:30	A pre-emptive tactic was deployed on a stolen vehicle where it collided with front of vehicle 2 and rear of vehicle 1.
22nd May	12:55	Officer in pursuit, vehicle failed to stop and intentionally reversed at speed and its rear end collided with front of officer's vehicle.
13th June	11:50	Police vehicle attended a road traffic collision, also in attendance West Wales Fire Service who positioned tender directly behind Police vehicle. Once incident dealt with Fire Officer prepared to move off but rolled into Police Vehicle.
30th July	21:20	Covert vehicle involved in pre-emptive TPAC Manoeuvre on suspect vehicle when subject was seen to panic and swerved hitting Police vehicle.

**Table 5.20: Hit by a third party - Blue lights were operational (unmarked)**

From Table 5.19 when the “blue lights” were off the difference in collision proportion when considering liability showed a similar trend. 8 collisions were considered the fault of the Police driver and 6 the fault of the civilian driver. This result was similar to the trend identified for the flashing headlights analysis and observed in Table 5.17.

### Sirens

Similarly, with flashing headlights and “blue lights” an analysis of the unmarked Police vehicles which were known to be on emergency response was conducted and therefore more importantly data was being recorded on the IVDR. By removing the cases where the IVDR was not working or IVDR was not fitted the remaining cases (n=18) were reviewed in Table 5.21.

		Liability		Total
		Hit 3 <sup>rd</sup> Party	Hit by 3 <sup>rd</sup> Party	
Sirens	On	0	1	1
	Off	8	9	17
	Total	8	10	18

**Table 5.21: Proportion of collisions where the Sirens were known to be available for operation.**

Only one case, shown in Table 5.22, existed where a collision occurred when the sirens were operational resulting in an incident where the third party struck the Police vehicle. The results were not statistically significant as assessed by Fisher's Exact test ( $p = 1.000$ ).

Date	Time	Initial Fleet Detail
22nd May	12:55	Officer in pursuit, vehicle failed to stop and intentionally reversed at speed and its rear end collided with front of officer's vehicle.

**Table 5.22: Hit by a third party where Sirens were operational (unmarked)**

This single incident, previously identified with the use of flashing headlights and “blue lights” also in use, showed that the collision was the result of a deliberate violation by the civilian and not driver error.

In cases where it was known, from the IVDR, that the sirens were not in operation immediately prior to the collision there was no real statistical difference in liability. 8 cases occurred where the Police vehicle hit the third party and 9 were as a result of the civilian hitting the Police vehicle.

**RQ6:** Does the operation of the Police vehicle emergency warning systems (marked vehicle) affect the collision liability?

### 5.7.9 Emergency warning systems - Marked

To establish if there was any influence on the liability of a collision between a Police vehicle and third party, the IVDR was examined. This was to establish which vehicles, known to be on emergency response from the Fleet report, were also recording activity of the warning systems in any combination, at the time or just prior to the incident occurring. Where the IVDR was not fitted and non-operational (not recording correctly) at the time of the collision the cases were discounted.

## *Headlights*

When operating as part of the overall warning systems , headlights flash alternatively left and right to attract attention and differentiate the Police vehicle from other road users, who may have their headlights on due to poor visibility. The data analysis resulted in 125 cases being identified, from the original 181, where it was known the headlights were definitively on or off. A Chi-square test of Association between liability and the headlights factor found that the results were not statistically significant ( $n = 125$ ,  $\chi^2(1) = 1.731$ ,  $p=0.188$ ). A crosstabulation of the use of flashing headlights immediately prior to a collision is shown in Table 5.23.

An inspection of the crosstabulation showed that there was a statistically non-significant trend towards a Police vehicle hitting a third party with flashing headlights operational as opposed to being hit by a third party with the headlights on. The results showed that a Police driver appeared to be 78% more likely (41 cases) to hit a third party (23 cases) when the headlights were on than be hit themselves. When the headlights were off there was minimal difference between the two groups. In this condition the Police driver was just 10% more likely to hit the third party.

		Liability		Total
		Hit 3 <sup>rd</sup> Party		
Headlights	On	41	23	64
	Off	32	29	61
	Total	73	52	125

**Table 5.23: Cases where the headlight usage was identified through IVDR at the time of a collision.**

A review identified that for the 41 cases where the headlights were known to be operational through the IR3+ data, showed that for 36 of those incidents the “blue lights” were also on. Where the civilian driver was found to be liable, of the 23 cases where the headlights were known to be on, the blue lights were also working in conjunction for 20 of those incidents.

### *“Blue Lights”*

The removal of cases where it was not known if the “Blue Lights” were in operation again left 125 cases remaining. The Chi-square test of Association found that the results were not statistically significant ( $n = 125$ ,  $\chi^2(1) = 1.301$ ,  $p=0.254$ ).

		Liability		Total
		Hit 3 <sup>rd</sup> Party		
Blue Lights	On	44	26	70
	Off	29	26	55
	Total	73	52	125

**Table 5.24:** Cases where the Blue Light usage was identified through IVDR at the time of a collision.

Table 5.24 showed that, as with the headlights there appeared to be a statistical trend towards the Police driver hitting a third party whilst the “blue lights” were in operation compared to being hit by a third party. There was a 69% (44 cases) increase in the chances of a collision occurring where the Police driver was blameworthy if the “blue lights” were in operation. If the “blue lights” were known to be off the result decreases to 11% on the part of the Police driver’s liability.

### *Sirens*

By removing cases where it was unknown if sirens were operational left 125 cases as identified by the IVDR. A Chi-square test of Association between the sirens and liability was not statistically significant ( $n = 125$ ,  $\chi^2(1) = 3.436$ ,  $p=0.064$ ). However, there was a statistically non-significant trend as shown in Table 5.25.

		Liability		Total
		Hit 3 <sup>rd</sup> Party		
Sirens	On	33	15	48
	Off	40	37	77
	Total	73	52	125

**Table 5.25:** Cases where the Siren usage was identified through IVDR at the time of a collision.

Inspection of the results showed that when sirens were operational a Police driver was more than twice as likely (120%) to hit a third party as be hit by a third party themselves. If the sirens were not operational the increase was 8% more in blameworthy collisions by the Police driver than the civilian driver. The non-operational results for the sirens were in line with those identified with the use of flashing headlights and “blue lights” which identified a 10% and 11% increase respectively.

A review of the 33 cases, (found in Appendix 13 and 14) where the sirens were known to be operational was limited to the Fleet report as the POLAC reports were not available in a large proportion of cases. An initial review of the cases highlighted causation factors including potentially higher risk driving by the Police officer, assumptions about the third party actions and poor observations based on the report made by the investigating officer and subsequent Fleet manager. The examples of higher risk taking included the following reports -

*On response call, came to lights which were against Officer, went through, MOP tried to stop but could not stop in time.*

*Officer on G1 call and drove on pedestrian areas to stop a fight but as he braked hard he slid and hit a pedestrian.*

*Police responding to immediate response, MOP exited roundabout to nearside to allow Police to make progress. At the point of collision, the width of the road was restricted, Police vehicle clipped offside of MOP vehicle.*

*Officer attending G1, whilst travelling along the road he negotiated offside bend then travelled on the incorrect side of the road colliding with the MOP.*

*Officer attending a G1, Officer had not anticipated vehicle 2 making right turn, as Officer approached vehicle 2 commenced turning, Officer overtook and struck offside of vehicle 2*

*Officer responding to call, overtaking vehicle and clipped wing mirror*

*Officer responding to G1 when confronted by oncoming vehicle in narrow road, passed slowly but Police vehicle grazed MOP vehicle.*

*Officer responding to G1 with “Blues and Two’s” illuminated, as MOP appeared from around the bend Officer pulled out and struck the vehicle.*

*Responding to G1, a Refuse truck was parked in road and Officers slowed to pass it but clipped wing mirror.*

There are indications that suggest the Police driver made assumptions about the actions of a member of the public.

*Officer attending G1 emergency. Officer positioned to offside of MOP. Unfortunately, MOP stopped behind to allow oncoming traffic to pass then proceeded to carry out right turn. Officer took avoiding action but collided with MOP.*

*Officer en-route to immediate response, Officer in offside lane of 3, approached build-up of traffic so slowed, vehicle 2 moved out but vehicle one moved directly into the path of the Officer*

*Officer en-route to emergency, “Blues and Two’s” on. As the van approached the same junction the 3<sup>rd</sup> party came to a stop. Officer thought that he had stopped for him to pass so moved to the wrong side of the road*

*Officer responding to G1 has passed a line of stationary cars. MOP tried to move out of the way but made contact with the HGV*

*Police vehicle and MOP both intended to turn left, Police vehicle on G1 call collided with each other*

Further documented events indicated that the Police driver may have had poor observations and narrower visual awareness in their approach to hazards.

*Officer attending G1. Vehicle in front moved to the side. Officer moved forwards but failed to notice another vehicle through the junction. Lights and sirens in operation*

*Officer responding to G1. Milk Float short distance ahead. Both collided. Milk Float did not hear sirens and Officer did not see the indicator.*

*Two Police officers responding to G1 call. The first vehicle stopped due to the actions of the MOP, second Police vehicle also responding failed to stop and collided with the rear of the first Police vehicle.*

It was not possible to attend any incidents, as all data was retrospective, nor was it possible to interview the Police driver involved. Many collisions happened some considerable time ago, so it was likely that some information would have been lost in the driver's memory for it to be a valuable exercise to undertake. The result of this is that impartiality can be neither proved nor disproved. From these inspections and the thematic analysis, the results are considered within the discussion.

## 5.8 Results Summary

This chapter considered the differences between marked and unmarked Police vehicles using collision data gathered from the Police Force over a 4.5 year time period. The purpose was to establish if any differences arose between both marking types thereby increasing the risk for either the Police or civilian driver.

An initial analysis of all collisions that occurred, regardless of the allocated reason by the Fleet department found that 10% of Police drivers in an unmarked vehicle will be involved in multiple collisions whilst those in a marked vehicle accounted for 30%. This suggested that reasons other than poor vehicle conspicuity could be influencing the collision rate and are considered further in the discussion.

An analysis of the time that a Police vehicle would be more likely to have a collision could not establish a difference between marked and unmarked vehicles . It was most likely to occur between 00:00 and 05:59 where both were more likely to be hit by a third party and in a large proportion of cases were due to the vehicle deliberately being hit by an offending vehicle attempting to avoid being stopped or subject to arrest. The collisions were a result of operational usage rather than vehicle salience differences. An interesting result occurred when emergency response collisions were reviewed in relation to the operation of the emergency warning systems and two distinct differences became evident.

For both unmarked and marked Police vehicles which were responding to an emergency event, but not displaying emergency warning systems, there was no difference in liability between the Police or the civilian driver.

However, for an unmarked vehicle that was displaying emergency warning systems all liability fell on the civilian driver, for reasons already highlighted as they were the result of a deliberate act to avoid being stopped. For a marked vehicle, switching on the emergency warning systems, saw an increase in Police liability of 78% for the use of flashing headlights, 69% for blue lights, and 120% increase for sirens in use. This has shown that driving a highly liveried Police vehicle does not reduce the chances of being involved in a collision with liability apportioned on the Police driver, rather than the civilian driver.

## Chapter 6: An observational approach to the interaction between Police and civilian vehicles (Study 3)

### 6.1 Overview

Previous chapters in this thesis have considered the views of the emergency services towards the civilian drivers who are required to move out of their way when responding to the actions of an emergency vehicle. The literature review noted that more highly trained drivers may find other drivers, who are deemed to be travelling slowly, a cause of frustration to them (Gulian et al. 1989; Trick et al. 2012). The earlier chapters also considered whether civilian drivers were more often responsible for collisions involving both marked and unmarked Police vehicles on response, and whether the emergency warning systems influenced the liability outcome.

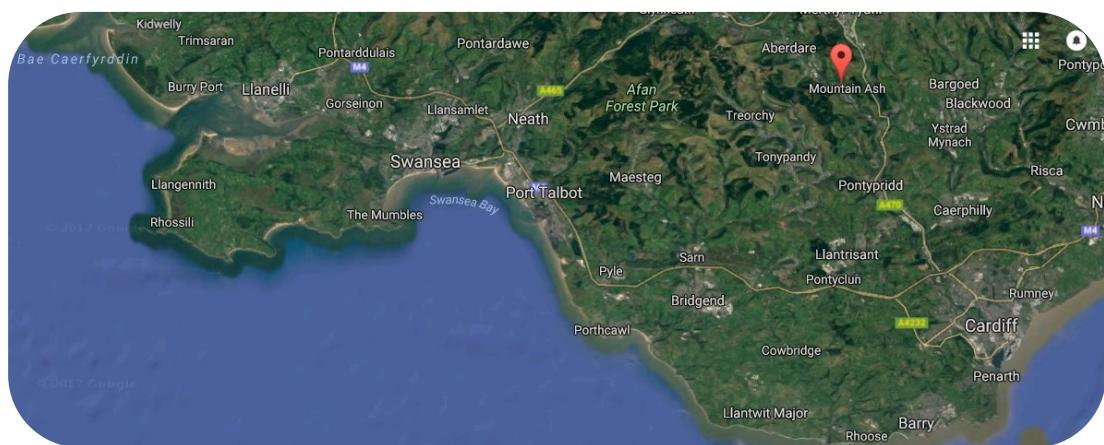
The earlier literature review also referenced several studies which referred to the way civilians drove when moving out the emergency vehicles way but offered little evidence to substantiate references to poor, or adverse driving reactions. Civilian drivers were described as unpredictable (Dorn et al. 2003; Shultz et al. 2009), reckless (USFA, 2002), panicked (Saunders et al. 2003; Gormley et al. 2008; Nakatani et al. 2009), confused (Caelli et al. 1980; Driver, 2008) and failed to give way due to inattention (Saunders et al. 1994).

Chapter 5 considered the physical collision data to determine if the civilian drivers were the principal cause of crashes, through quantitative analysis, but could not evaluate near misses, negative behaviours or driving actions which may be an inconvenience to another road user without creating an actual crash. Near misses, described as an incident that had the capacity to cause injury but did not, either due to intervention or chance (Aspden, Corrigan, Wolcott and Erickson, 2004), occur more frequently than crashes. The number of collisions specifically between a Police vehicle and third party was low compared to both the overall number of collisions that occurred with South Wales Police and the number of G1 calls (those requiring immediate driver response as discussed in Chapter 2) responded to (Appendix 11). These findings, relating to higher proportions of near misses than crashes supported a study by Guo, Klauer, Hankey and Dingus (2010). Guo et al. (2010) found near misses were likely to occur at between 10-15 times more often than the crashes themselves enabling researchers

to have a better understanding of the relationships being investigated. The researchers additionally identified that naturalistic monitoring could provide a valuable insight into driver behaviours and the environment in which they were observed.

For this thesis the approach of gathering and investigating real world driving, in an unobtrusive manner, supported quantitative data gathered from collisions reported in chapter 5 and provided additional insight into both Police and civilian driving.

The study was conducted within the South Wales Police Force. It covers all road types (Motorway – M4 which is the only motorway in Wales, Dual carriageways, A ‘Roads and rural roads) and urbanisations (City, Urban, Residential, Villages) as shown in Figure 6.1.



**Figure 6.1: Satellite image of South Wales showing built up areas (Google Maps)**

This study observed the driving style of the individual in a non-intrusive way and from an external viewpoint so was not able to observe the driving behaviours or distractions of the actual drivers at that time. However, gathering data in this manner assisted in providing a deeper understanding of the real situation and any events leading up to the event itself.

## 6.2 Research question

**RQ7:** Do civilian drivers react in an adverse driving manner when moving out of the way of a Police vehicle whilst on response?

This study, using real world observations described below, aimed to establish if civilian drivers react differently when interacting with an emergency vehicle on a response call. Whilst naturalistic data collection is a common research method, the use of Police Automatic Number Plate Recognition (ANPR) data has not previously been used to evaluate driving behaviour in this type of driving situation.

### **6.3 Data collection**

This study used an observational approach utilising footage gathered from a Roads Policing response vehicle to establish how civilian drivers responded when they observed a Police vehicle using emergency warning systems approaching them with a view to overtaking. Several studies have used this method to observe or monitor specific driver behaviours such as fatigue (Barr, Yang, Hanowski and Olson, 2011), mobile phone use (Rosenbloom, 2006), and driving distractions (Prat, Planes, Gras and Sullman, 2015). The methods can vary in duration from short term to many months and using from one to numerous vehicles as for example the 100 car study (Dingus et al. 2006). Carsten, Kircher and Jamson (2013) identified three specific methods for conducting on-road studies. The first is a “controlled” investigation which can collect data over minutes or hours of observed driving and is typically small in nature. Specifically, it considers how behaviours such as fatigue, alcohol and different distractions affect driving alongside any intervention. Whilst it can focus on highly tailored research questions, it often involves observing driving over a pre-set route so that differences can be identified under varying conditions. The advantage of this method is therefore that those conditions can be controlled such as weather, time and traffic. Within this study there was no access to either Police and civilian drivers to establish if individuals were affected by cognitive or physical influences which then altered their reaction around a Police vehicle. Therefore, this method was not utilised in this study.

The second method is a “Field Operational Test” where the data collection is principally through instrumentation over a long period of time with the advantage that data collection can be continuous even when the participants are going about their everyday lives. The collection of the data can evaluate how a driver may interact with an assistance system and whether it may influence driver behaviours. However

instrumental data was not collected from either the Police or civilian vehicle in relation to how the vehicle was driven such as through braking and acceleration. As such this was not considered an appropriate method in this study. Drivers are then asked about their acceptance of the system through a questionnaire but for this study there was no access to drivers retrospectively. Video and instrumentation data are collected continuously in this method for each driver but within this study the short and often immediate interaction a driver may have with an emergency vehicle was part of the research. Therefore, the method was not suitable for this study to use further and as such discounted.

The last method identified by Carsten et al. (2013) was “naturalistic” which allowed for the collection of baseline data in ordinary driving. It enables real world reactions and relationships between road users to be investigated unobtrusively (Barnard, Utensch, van Nes, Ennink, Baumann, 2016). Several studies have collected driving data through the use of simulators, but this can limit the realities of what happens on the roads due to drivers knowing it is experimental (Langham et al. 2002; Taib et al. (2014). In naturalistic and real world investigations the participants are not directly involved in the data collection and therefore less able to identify the study aims and as such reduce biases (Barnard et al. 2016). For this study it was proposed to gather video footage from a Roads Policing as it was accessible data which could be collected unobtrusively as suggested in the literature. It gave a unique perspective in how civilian drivers reacted around a responding Police vehicle which would then meet RQ7. This method was utilised by Burke et al. (2001) to observe the behaviour of Fire service drivers. As such the thesis study is considered to fall within the category of real world observations as identified by Carsten et al. (2013) and was the method chosen.

Welsh et al. (2010) examined the requirements for correct collection of real-world data and effectively defined three categories namely data acquisition, data storage and data analysis. Their research relates to our study in many respects and formed the framework for data collection where possible.

With data acquisition there is clearly a need for good video quality such as resolution, positioning and several camera angles. This advice applies to general studies where

there is control of where cameras are placed which was not available in this study due to the vehicles being operational Police vehicles. However, the College of Policing (College of Policing<sup>15</sup>) do advise on similar points with the use of ANPR, in that it can be affected by the number and type of cameras, location of those cameras, image quality as a result of sun, reflection, poor lighting, vehicle speeds, and poor weather. ANPR not only records and identifies vehicles of interest from vehicle registration plates but also has a live video function. It can record if a Police vehicle is over the prescribed speed limit or can manually record if requested / required by the Police driver to gather evidence of a civilian's driving. The footage is stored onto an inbuilt vehicle hard drive which can then be accessed by the Police and downloaded on to a portable hard drive as necessary. Using a dedicated computer, the data is unencrypted on to a CD for viewing or for evidential Court purposes. The hardware has the facility to record sound which transfers to the CD, if required.

Quality issues were evident with the data collected in this study as the ANPR normally provides a grainy image and would not allow determination of fine detail (Figure 6.2), but for the purposes of observing an overall behaviour, it did not prove to be a limiting factor. Additional data was collected using a pre-fitted dashcam where visual quality was more enhanced (Figure 6.2).



Figure 6.2: Image extracted from ANPR (left) and a dashcam (right)

One further point made by Welsh et al. (2010) was that any driver observations would be required to be as unobtrusive as possible so that the driver does not modify his or

<sup>15</sup> College of Policing ANPR [Online] <https://www.app.college.Police.uk/app-content/investigations/investigative-strategies/investigative-strategiesanpr/?s=ANPR#limitations>

her driving accordingly. This type of behaviour change was named as the “Hawthorne Effect” in the early 1950’s by a researcher Landsberger and is a term still widely used. The effect says that if someone believes they are being observed or if someone is taking an interest, they are more likely to modify their behaviour. In the case of this research the change of behaviour was the study aim as it was hypothesised that drivers do not change their driving, in an adverse way, regardless of whether they observe an unmarked or marked Police vehicle on response.

Data storage for this study and in line with Welsh et al. (2010) noted that the procedures for removal of data from hardware and the upload procedure itself was vital to reduce the chances of data loss. For this study two methods of data capture were used and therefore two methods of data storage were adopted which are detailed below.

In the UK, within emergency vehicle fleets, there is no standardised system or even legal requirement for on-board cameras to be fitted for training, law enforcement or insurance purposes. Different services choose varying methods according to preference or need. For the purposes of this study data was collected from two systems used by Roads Policing vehicles but all data was reviewed with the same criteria method.

Two systems were used to maximise the volume and opportunities to capture the data and this is now detailed below for the two methods.

### *Method 1*

All UK forces can decide on the recording equipment they feel best suits their operational requirements, meets quality standards and (often) available budgets.

One of those demands can be Pursuits, considered in chapter 6, with the College of Policing (College of Policing<sup>16</sup>) providing the following criteria, for both IVDR and video evidence:

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<sup>16</sup> College of Policing *Road Policing. Police pursuits.* [Online] <https://www.app.college.Police.uk/app-content/road-policing-2/Police-pursuits/>

*“It is highly desirable in pursuit situations to use vehicles fitted with IVDR / driver and vehicle data management systems (DVDMS), together with visual recording equipment, for evidential purposes. Such vehicles should be deployed to take part in pursuits where possible”*

DVDMS systems hold information about drivers and vehicles which are stored on central Government databases, including vehicle owner, driving licence, insurance, roadworthiness certificates and vehicle taxation.

Visual recording equipment must:

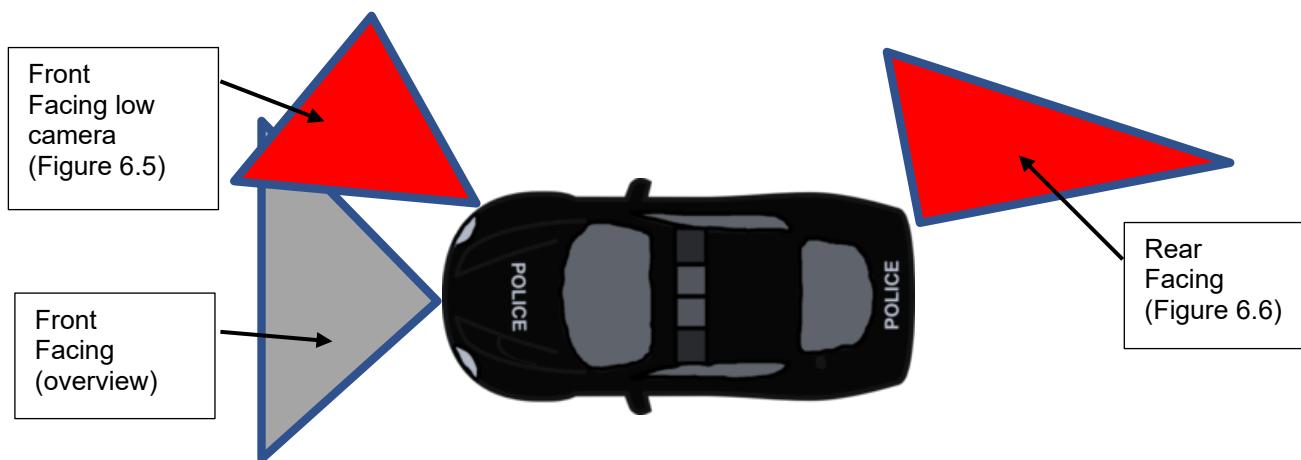
- *be properly maintained and used during pursuits and emergency responses*
- *not be switched off prior to or during pursuit activities*
- *be in working order, if not, Force reporting procedures should be followed, and repairs undertaken at the earliest opportunity.*

The Force studied uses a commercial system known as “Cleartone” which continually records video data when the vehicle is operating under “blue lights”, flashing headlights and / or sirens. The generic system, or ANPR, records and identifies vehicles of interest from number plates alongside a live video function (Figure 6.3).



**Figure 6.3: Example of data capture from “Cleartone” system**

The “Cleartone” or ANPR cameras are fitted to both front and rear of the vehicle (Figure 6.4) but for the purposes of this study only forward-facing overview footage was reviewed and analysed. This is because the forward facing camera provides environmental context (Figure 6.5) and an overview of the situation ahead, but the rear cameras were prepositioned too low (Figure 6.6), so no usable data could be gathered for the purposes of this study.



**Figure 6.4 Camera view and positioning on the Police Vehicles**



**Figure 6.5: Front facing camera images taken during the night (left) and day (right)**



**Figure 6.6:** Rear facing camera images taken during the night (left) and day (right)

The Police vehicle type, namely marked and unmarked, was noted against the video data footage gathered for the purposes of comparison.

The downloading of ANPR data required the Roads Policing vehicles to be physically present and it was possible to download this information over several sessions at Police premises. However, it proved difficult to access data operationally and therefore data was not gathered at the rate expected, a data collection limitation noted also by Carsten et al. (2013). Video clips were initially saved on the vehicle hard-drive once the Police driver pressed the ‘record’ function on the ANPR (usually for evidential reasons). Furthermore, the system automatically started the recording function when the vehicle exceeded any speed limits (known as “over-speeding”). If the officer did not extract the recorded information the system overwrote the record of previous data once the hard drive was full.

### *Method 2*

In order to enhance the data collection a second method of data capture made use of small forward-facing cameras mounted behind the interior mirror known as “dashcam” which were originally fitted (for operational reasons) to marked Police vehicles (in this case, BMW estate cars). It was decided to utilise this information as an additional data source.

Two 16MB SD cards were given to a Roads Policing officer for data collection as part of this study. This was collected, downloaded and then returned to the officer on two

further occasions for additional data collection. This provided 6 x 16MB of data capture. The camera could also be turned on and off manually so theoretically would be more effective at capturing only emergency response or “blue Light” events.

Due to the nature of the role within Roads Policing, drivers often have the same vehicle allocation, so it was possible to brief one of the drivers on the type of data required. This was so that the driver could select trips for recording that involved heading into locations where traffic was likely to be present and thus allow capture of different driver behaviours.

The final consideration by Welsh et al. (2010) was data analysis. In the case of this study, the footage was viewed using a freely available multimedia viewing platform known as VLC (VideoLAN). Each clip was referenced, and a database created which can be found in Appendix 17.

One of the limiting factors of the “dashcam” is that while footage displays the date and time it does not illustrate the vehicles speed, whereas the ANPR system does.

For the data collection in method 1 it was recognised that the vehicles (both marked and unmarked) would be capturing response drives either due to the “over-speeding” functionality which automatically recorded or where a drive was specifically recorded for evidential purposes such as a pursuit or specific Police tactical manoeuvre (i.e. TPAC). The second method, utilising the availability of the dashcam, the driver was fully briefed and was asked to record any incidents where the Police driver felt that the civilian driver was not driving appropriately. The data collected was unobtrusive to civilian drivers as they were not aware of being recorded and therefore, it was considered that they would not immediately alter their driving. The cameras were however able to record data which highlighted how civilian drivers responded when the Police vehicle was making a passing manoeuvre on an emergency drive. Guo et al. (2010) noted that the recording of near crashes or ordinary driving allowed for sensitive analysis which was not possible with crash data. Due to the limitations of the study methodology, the researcher was not able to view the data until after it had been downloaded. As also found by Carsten et al. (2013) the study was somewhat limited

to events to which the Police vehicle was exposed to. However, this methodology is typical of real-world driving data capture (Welsh et al. 2010).

## 6.4 Methodology

### 6.4.1 Vehicles and Driver qualifications.

The vehicles were driven by Roads Policing officers who had all completed training at Advanced level, which includes pursuit training. Confirmation of driver qualification was carried out with the Force retrospectively using the officers' collar number collected as part of the initial data gathering process. The drivers' training level is in line with the ACPO guidelines ([www.ipcc.gov.uk](http://www.ipcc.gov.uk), p19) and indicates they were suitably trained for the demands of the role they were undertaking.

There are three categories of Police driver with Advanced being the highest. The College of Policing (College of Policing<sup>17</sup>) define a Standard response driver as "*trained to enable them to respond safely to incidents requiring a legal use of exemptions*". However, an Advanced driver is "*trained to a higher level than Standard / Response enabling them to drive high performance vehicles operationally*".

The vehicles were high performance BMW's, which were both unmarked and marked Police vehicles and all were fitted with emergency warning systems. Data from ANPR and the dashcam was downloaded, referenced and stored on CD's and SD cards in a secure location.

### 6.4.2 Taxonomy

Prior to the study, various methods for developing a suitable hierarchy or "taxonomy" of driver behaviours were considered.

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<sup>17</sup> College of Policing *Driver/rider levels and vehicle categories* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/?s=high+performance+vehicles>

The first was the DVLA's DL25 ([www.dvla.gov.uk](http://www.dvla.gov.uk)) marking scheme for those undergoing licence acquisition which in the data marks against specific skill-based driver faults such as lack of use of mirrors, timing of the signals and lane discipline and can be found in Appendix 3. The driver behaviours captured in the footage were considered too broad for this type of marking, as the faults were not skill based but were often as a result of a conscious decision. This method was therefore rejected.

The second method considered was the creation of a bespoke marking system that focussed more on behaviours rather than skills. This was also rejected as it had not been validated against other studies which made it open to criticism.

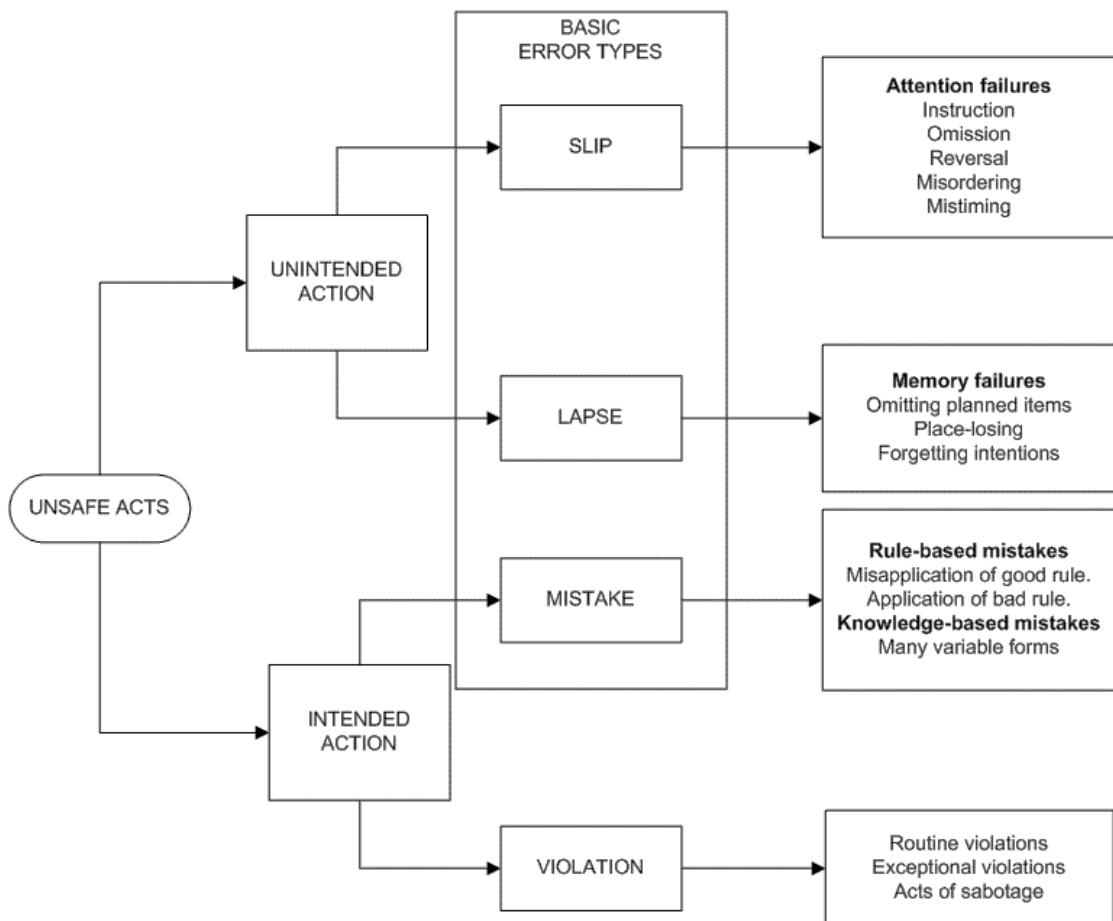
Early work by Norman (1981) considered driving errors in relation to the failure of schemas, and found errors with the misinterpretation of a situation, faulty activation of schemas and schemas activated too late or too early. Norman's research focussed around slips and errors as two categories and did not provide a formal framework. However, it was decided that this would not be detailed enough for the type of analysis being conducted, specifically within the driving context.

Therefore, a method of categorisation which was academically validated and robust was selected which was without complications for the data size. In relation to this, Reason (1990) developed a method of defining unsafe acts, as slips, lapses, mistakes and violations, which has been adopted within Health and Safety documentation known as HSG48 and safety critical environments ([www.hse.gov.uk](http://www.hse.gov.uk)<sup>18</sup>). This method of defining aberrant acts was considered the most appropriate in this study. This method has also previously been used in driving research including the formation of the Driver Behaviour Questionnaire - DBQ (Reason et al. 1990). The categorisation of errors and violations was found to be relevant in previous studies for all drivers including professional groups (de Winter and Dodou, 2010; af Wåhlberg, Dorn, and Kline, 2011). It was also determined that if errors and lapses were combined, they could be as much a predictor of crashes as violations could be (also supported by af Wåhlberg et al. 2011).

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<sup>18</sup> HSE Reducing error and influencing behaviour [Online] <http://www.hse.gov.uk/pubns/priced/hsg48.pdf>

As illustrated in Figure 6.7, Reason (1990) proposed several categories, based on Rasmussen (1983) to define behaviours which were both intentional and unintentional.



**Figure 6.7: Reason (1990) Summary of Unsafe Acts**

The definition of the various 'Unsafe Acts' are as follows;

**Unsafe Acts** Defined as an error or violation committed in the presence of a potential hazard. For example, if a driver chooses not to wear a seat belt, this is not an unsafe act but when the vehicle is in close following mode at 70 mph on a Motorway it could be considered so.

Unsafe acts can be both unintentional and intentional. Reason (1990) defined unintentional acts as an unwitting deviation of action from the intention and are known as slips and lapses.

*Slips.* A slip is considered to have happened when an action which is frequently performed goes wrong. For example, a driver flashes their headlights instead of operating the windscreen wipers. Slips offered a potential or definite risk to others (Reason et al. 1990).

*Lapses.* A lapse of attention or concentration happens perhaps through a momentary distraction such as forgetting to indicate at a junction, attempting to drive away from stationary in third gear or missing a road junction through daydreaming. A lapse was considered to be of no risk to others (Reason et al. 1990).

However, whilst some actions may be unintentional, others can be considered deliberate and therefore Reason (1990) considered a sub-classification of mistakes and violations.

*Rule based mistakes.* To perform a task at any level, a person must have stored memory or schemas (Ling and Catling, 2012 p65; Craik and Lockhart, 1972). A rule-based mistake is based on the inappropriate application of remembered rules and procedures, such as a misjudged overtake in an unfamiliar vehicle, or getting into the wrong lane on a previously encountered roundabout.

*Knowledge based mistakes.* This is where there is no previous experience or routine available to facilitate dealing with a situation and therefore an individual relies on problem solving, such as how to deal with a tram system in an unfamiliar city. Without enough knowledge to deal with unfamiliar situations, mistakes are inevitable.

*Violations.* These are a deliberate breach of the rules such as speeding or continuing through a red light. Violations can be categorised further to consider whether the violation was unintentional (routine violation) such as unknowingly speeding, if it was deliberate (where there was there an intention to cause damage (sabotage) such as deliberately driving into another vehicle), or it occurred due to a unique set of circumstances (exceptional).

Different categories of errors together with example behaviours as proposed by Reason (1990) are shown in Table 6.1.

<b>Category of Error</b>	<b>Example behaviours</b>
Slip (attentional failure)	<ul style="list-style-type: none"> <li>▪ Driver indicates the wrong way.</li> <li>▪ Exit on wrong lane of roundabout.</li> </ul>
Lapse (memory failures)	No clear recollection of the road just travelled.
Rule Based Mistake	<ul style="list-style-type: none"> <li>▪ An act by the Police driver which contravenes driver training previously received.</li> <li>▪ Brake too quickly on a slippery road, steer the wrong way in a skid.</li> </ul>
Knowledge based mistake	<ul style="list-style-type: none"> <li>▪ Hesitation in how to act correctly when interacting with a Police vehicle on response (poor decision making).</li> <li>▪ Causing an obstruction</li> <li>▪ Misjudge gap in a car park</li> </ul>
Routine violation	<p>An act which contravenes the UK Road Traffic Act</p> <ul style="list-style-type: none"> <li>▪ Driving on a kerb</li> <li>▪ Crossing a red traffic light</li> </ul>

**Table 6.1: Reason's (1990) categorisation of errors and examples of associated behaviours**

Whilst this study used the categorisation developed by Reason (1990), later taxonomies were developed based on Reason's (1990) taxonomy. For example, Wierwille, Hanowski, Hankey, Kieliszewski, Lee, Medina, Keisler and Dingus (2002) reported that driver error could be defined by four categories. These were human conditions and states, human direct causes, environmental factors and vehicle factors. The human conditions covered such states as impairment through drugs, alcohol or emotionally upset and with the data set being of an external vehicle observation it would not be possible to determine this condition. This taxonomy was therefore further rejected, despite building on previous work by Reason (1990).

Only clips which involved an emergency response and a subsequently identified behaviour were categorised for errors, to investigate the study aim. A late reaction by a driver was considered to have occurred when it could be determined that the reaction time was over 2.5 seconds, measured initially from the time the vehicle came into view to the actual commencement of movement across. The evaluation of what was an acceptable reaction time was previously considered in the literature review (Triggs et al. 1982; Taoka, 1989).

#### *6.4.3 Data Analysis*

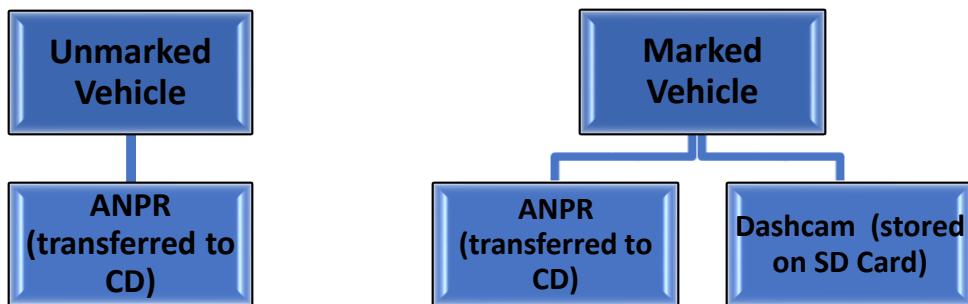
Using the methodology above and the defined error categories, each clip was viewed in full. Clips where a Police Vehicle could be seen to be operating their warning systems, and where their speed could be visually seen to reduce significantly due to slower-moving traffic in front were considered further. An error type was noted against each clip using the categorisation above in Table 6.1 if it were considered that any driver could have acted in a more appropriate manner.

In order to independently analyse the real-world data and to remove any researcher bias the clips were reviewed by three Police driving experts. The experts were selected based on previous role within Police driver training and all held an MSc in driver behaviour which gave them insight into driver behaviours such as that then utilised with Reasons (1990) taxonomy. Each expert was not in contact with the other at the time of the review so were not able to confer on any findings. Each provided verbal feedback on the clips which was written down and subsequently included in full in this study.

### **6.5 Results**

Once data had been collated and unencrypted (in the case of the ANPR data on to a CD), a full review of each clip took place. A reference was given to each clip namely ANPR data CD--(number), and SD cards from the dashcam were referenced as BL--(number) or Non -- (number). A full list can be found in Appendix 17.

The results were split into two main areas for comparison, namely Police vehicle markings, and were collected from two sources, as illustrated in Figure 6.8.



**Figure 6.8: Summary of Video footage categorisation and collection sources**

The observational data was gathered at random time intervals as determined by operational requirements and the study had no control over this factor. This resulted in a large number of clips not containing footage of emergency responses. Each clip was reviewed as there was no way of knowing upon downloading what detail was contained in terms of the operation of the warning systems and any associated or independent adverse driving behaviours. It was decided not to discard the clips, where no aberrant behaviour was observed or where there was no emergency response, as it provided a representation of the real-world situation. If clips of only emergency runs had been gathered or retained it could potentially have appeared that any near misses or examples of poor driving could have been more significant in number, than was the case.

Research question 7 asked “Do civilian drivers react in an adverse driving manner when moving out of the way of a Police vehicle whilst on response?”. Therefore, the video clips were viewed, by Police driving experts (referred to as Expert A, B and C) to establish any possible negative driving behaviours. To confirm if they were in line with Reason’s (1990) taxonomy one expert was consulted in order to ensure correct categorisation of errors or violations. This would include any driving where Legislation was breached, near misses with other road users occurred, and driving that would not

be considered usual or acceptable for a driver, whether civilian or Police, whilst completing a journey.

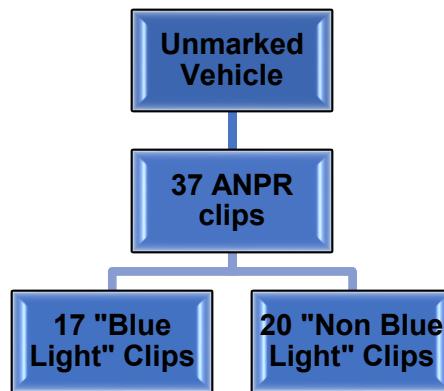
In addition to the “taxonomy” a narrative was included to describe the road type, weather, lighting and overall event.

### **6.5.1 Unmarked Vehicles – data collected from ANPR**

Data was also downloaded from the unmarked Police vehicle that was not on operational duty at the time of data collection. As with previous research in chapter 5, which investigated collisions involving an unmarked Police vehicle, it was observed that there were proportionally far fewer unmarked vehicles in the Roads Policing Fleet than those that were liveried. In this study, the volume of observational data gathered unintentionally reflects the low number of vehicles and could be considered a limiting factor due to the small number of clips collected. Each clip downloaded from the Police vehicle on to a CD was labelled as originating from an unmarked vehicle. A CD was required for data storage as the process of unencrypting on specialist equipment could not be completed by any other manner. The total number of clips available using this method totalled 37 as detailed in Table 6.2.

Total number of clips	37
Total collected footage time	1hr, 37min, 58sec
Total “Blue Light” footage time	32min, 02sec

**Table 6.2: Total footage for unmarked vehicles from ANPR**



**Figure 6.9: Unmarked Police vehicle ANPR data collection volumes and analysis**

Twenty “non-emergency” clips were discarded for the purposes of the study. On viewing these 20 clips it was evident that the Police vehicle was driving under ordinary conditions with no emergency warning systems operating and the vehicle speeds were comparable to that of civilian drivers. As this study investigates driving behaviour of both civilian and police driving around a vehicle on response, it was determined that these clips fell outside the study scope.

Of the 17 clips which involved the use of the emergency warning systems, three were considered to have shown an adverse response from a driver, in this case a civilian by independent experts (Table 6.3). Stills taken from the clips just prior to the Police vehicle attempting to pass are shown below (Figure 6.10 to 6.12) to illustrate the environmental conditions at the time. For each clip, the delay was measured from the point when the vehicle ahead came into view on the ANPR (and so would have been seen by the driver), until the vehicle then moved across to another lane.

#### *Adverse ANPR unmarked Police vehicle events*

The clips were reviewed by the Police Driving experts (A, B and C) who were experienced in both driving errors and the application of Reason’s taxonomy categorisation of errors.

CD Ref	Total footage duration (sec)	Total Blue Light duration (sec)	Vehicle Type	Description of adverse event	Overall clip speed variance	Time and location filming occurred	Error
16	74	74	Car	<b>Figure 6.10</b> 1 car in Lane 2 of 2. Did not notice unmarked Police Vehicle with Lights operating. PV speed dropped from 100mph to 76mph before car moved to Lane 1 after 10s.	125mph down to 76mph	20:54 Dual (Lit)	Civilian Lapse
25	77	77	Motorhome	<b>Figure 6.11</b> Motorhome in Lane 3. Did not move over initially and delayed for 10 seconds. Police Vehicle speed went from 113mph to 75mph before the Motorhome moved over to Lane 2.	123mph down to 75mph	10:06 M/Way	Civilian Lapse
28	72	72	Car	<b>Figure 6.12</b> Late identification of the Police Vehicle by the car whilst travelling in Lane 3. Police Vehicle speed went from 105mph to 75mph before the small car then moved to Lane 2 after a delay of 8s.	123mph down to 75mph	10:02 M/Way	Civilian Lapse

Table 6.3: Summary of adverse events from unmarked Police vehicles using ANPR



Figure 6.10: Vehicle ahead of rear approaching unmarked Police vehicle (CD16)



Figure 6.11: Motorhome ahead of rear approaching unmarked Police vehicle (CD25)



Figure 6.12: Car ahead of rear approaching unmarked Police vehicle (CD28)

All three identified cases were on a high-speed multi-lane road (Dual Carriageway or Motorway) during daylight or were well-lit with street lighting. The maximum speed limit for any driver in a car, not on response, was 70mph on this type of road. All events were due to the civilian vehicle in front of the Police vehicle not immediately noticing that the unmarked Police vehicle was approaching from behind and then subsequently failing to move over to the left in a timely manner (over 2.5 seconds). This resulted in the Police vehicle reducing speed from 113mph, 105mph and 100mph respectively down to 75 – 76mph (in each case) before proceeding. The lack of observations was classified as a “lapse” in the taxonomy.

### 6.5.2 Marked Vehicles

In total 373 separate clips were collected for a marked Police vehicle of varying time durations using the two differing methods, as collated in Table 6.4. The number of clips from each source is shown in Figure 6.13.

Total number of clips	373
Total collected footage time	13hr, 33min, 41sec
Total number of “Blue Light” clips	110
Total number of “Non- Blue Light” Clips	263
Total “Blue Light” footage time	3hr, 33min, 50sec

Table 6.4: Total footage for marked vehicles from ANPR and SD cards

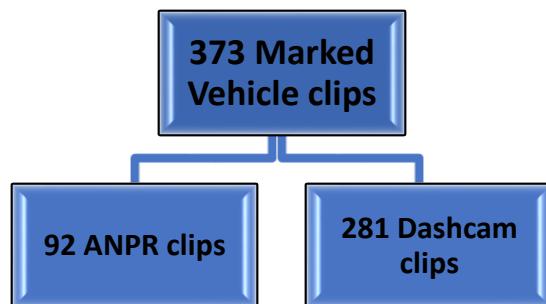


Figure 6.13: Marked Police vehicle ANPR data collection volumes and sources

### 6.5.2.i. Marked Vehicles – Data collected from ANPR

Method 1 saw a total of 92 clips (Table 6.5) being gathered which were then initially screened by the researcher. 55 clips were identified as being captured during an emergency response as shown in Figure 6.14.

Total number of clips	92
Total collected footage time	3hr, 34min, 34sec
Total "Blue Light" footage time	1hr, 50min, 11sec

Table 6.5: Total footage for marked vehicles from ANPR

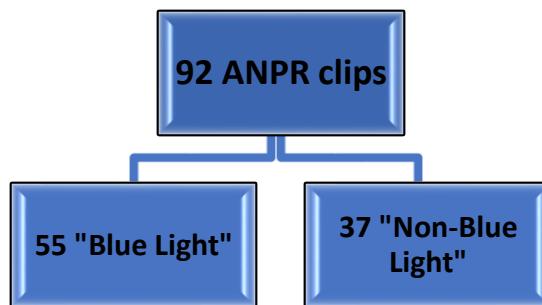


Figure 6.14: Marked Police vehicle ANPR data analysis

#### *Adverse ANPR Marked events.*

Having removed the 37 non-emergency response clips (shown in Figure 6.14), analysis of the 55 “blue light” clips, from the ANPR vehicle data source, resulted in 6 events identified as warranting further investigation. The 6 events contained in 5 clips were deemed to be a) an emergency response and b) involving an adverse driving behaviour. Similarly, as with the unmarked Police vehicles, 4 events resulted in the civilian driver not immediately reacting to the impending vehicle from behind, in broad daylight on a National Speed Limit (NSL) road (Dual Carriageway / Motorway). NSL roads carry the highest legal speeds allowable in the UK.

Following an initial screening of the clips, the Experts reviewed the clips in line with Reason’s taxonomy.

CD Ref	Total footage duration (sec)	Total Blue Light duration (sec)	Vehicle Type	Description of adverse event	Overall clip speed variance	Time and location filming occurred	Error
14	125	125	Van	<a href="#">Figure 6.15</a> Red Van Lane 3. Police (headlights but no blue lights) before moving over to Lane 2 after 8s.	From 120mph down to 70mph	15:36 M'Way	Civilian Lapse
56	79	79	Van	<a href="#">Figure 6.16</a> Car and then van did not immediately notice. Delayed reaction of 9s.	From 126mph down to 77mph	13:54 Dual C'way	Civilian Lapse
67	938	938	HGV	1. <a href="#">Figure 6.17</a> and <a href="#">Figure 6.21</a> (1-7) Tactical stopping manoeuvre (TPAC) caused an HGV to brake hard due to Police error	126mph to a stop	12:31 Urban/ M'Way	Police Rule based mistake
			Car	2. <a href="#">Figure 6.18</a> Car moved late to Lane 2 (120s in to footage). 4 Police vehicles behind them with a delay of 7s.			Civilian Lapse
70	241	241	Car	<a href="#">Figure 6.20</a> (108s into footage). Vehicle starts move onto RH lane with near miss on PV at 128mph. Vehicle subsequently pulled over by Police	135mph to a stop	21:50 Dual C'way	Civilian Lapse, Police Rule based mistake
73	76	76	Car	<a href="#">Figure 6.19</a> Late reaction of cars in Lane 2, of 12s, which eventually moved to Lane 1	128mph down to 68mph	10:44 Dual C'way	Civilian Lapse

Table 6.6: Summary of adverse events from marked vehicles using ANPR

Four events were considered as lapses within the taxonomy as the civilian drivers failed to move to the left in a timely manner. As with the previous three events identified for the unmarked Police vehicles in Table 6.3, all occurred on a Motorway or Dual Carriageway, where visibility was good. Photos taken from the footage are shown for illustration purposes and are referenced Photo 6.15 – 6.19.



Figure 6.15: Red Van ahead of rear approaching marked Police vehicle (CD14)



Figure 6.16: Large SUV ahead of rear approaching marked Police vehicle (CD56)



Figure 6.17: 4 marked Police Vehicle commencing convoy to execute a TPAC (CD67)



Figure 6.18: Cars ahead of 4 rear approaching marked Police vehicle (CD67)



Figure 6.19: Cars ahead of rear approaching marked Police vehicle (CD73)

One incident, captured in Figure 6.20, involved a two lane National Speed Limit Dual Carriageway at night. One Police vehicle had already passed through using their warning systems, however the 2<sup>nd</sup> Police vehicle (with full emergency warning systems in operation) was involved in a near miss event (Dingus et al. 2006) with a vehicle in Lane 1, which had signalled and then immediately began to move into Lane 2. The Police Vehicle which was travelling at 128mph took evasive action narrowly avoiding a collision. The Police speed is evidenced on the video screen and would mean that the Police vehicle itself was covering approximately 64 metres / second.

ACPO guidelines (IPCC, 2007 p 44) state that “*when more than one Police vehicle is engaged in a pursuit, each vehicle should use a different audible sound to warn other motorists to the presence of more than one Police vehicle especially since members of the public may not expect there to be more than one vehicle*”. In this case the initial Police vehicle was operating rear “blue lights” on an unlit high-speed road at night which caused a “halo” (Spencer et al. 1995; Streid, 2001; Flanagan et al. 2008) and therefore the possibility exists that the civilian driver was either temporarily distracted or that their vision was impaired. To establish whether blame could be apportioned in part to the Police driver, rather than wholly to the civilian the clip was reviewed by a Police driving expert (later referenced as Expert B).



**Figure 6.20: Car pulling out in front of second rear approaching marked Police vehicle (CD70)**

Expert B analysed the clip to form an opinion as to the driver reactions from both parties and as such is detailed below:

***"30/8/2014. Near miss on A4232. Speed 128mph followed by harsh braking.***

*In this incident we have two Roads Policing cars travelling into the city of Cardiff at high speed. The road infrastructure at this location is a dual carriageway of two lanes in each direction. The lanes are separated by ARMCO safety barriers. There is no running hard shoulder.*

*During the video clip you can see the two Police vehicles travelling at approximately 120-130 mph. The front vehicle has its emergency lights illuminated giving the impression that both vehicles are attending an incident warranting an emergency response. The lead Police car is seen passing two vehicles to its nearside on an offside bend. As the second Police vehicle is about to pass the two cars in the nearside lane the rear most vehicle starts to pull out into the path of the Police vehicle causing excessive emergency braking to be applied by the Police driver. A collision is thankfully avoided. A short distance later, the Police driver stops the vehicle which had pulled out and speaks with the driver, one can only assume to challenge him on the incident.*

*My concerns with this as a driver training lead are as follows:*

*Officers are taught, when responding, not to respond in pairs as the public will respond to one emergency vehicle not suspecting the second and pull out. Generic learning is to leave a 30 second gap between responding vehicles. Therefore, in this case the Officer in the rear car was travelling too close to the lead Police car.*

*The fact that the officer is an Advanced driver would make me assume that he should have been applying the Roadcraft principles when closing on the two nearside vehicles. i.e. What can I see, what I cannot see, what I may reasonably expect to happen, what is my most critical hazard and what is my contingency plan.*

***In this case I would have expected the Police driver in the second car to have made the following driving plan.***

*What can I see; two cars in the nearside lane, with the rear car close to the car in front (assumption that it may pull out)?*

*What can't I see, is the decision making of that driver?*

*What may I expect to develop? The civilian car's proximity to the car in front, currently in Lane 1, may create an overtaking incident? Based upon experience the car will potentially move before the driver checks its mirror. Additionally, the driver may have seen the lights of the first Police car and not those of the second car; this would give them the opinion that it was now safe to pull out.*

*This car then becomes the most critical hazard. My immediate risk assessment would be to start slowing down in anticipation of it moving into my lane. The video shows no speed retardation, which means the Officer has made a decision, or lack of, that it was safe to continue.*

*When the vehicle did pull out it becomes a near miss due to the lack of a contingency plan being applied by the Police driver."*

RQ5 aimed to establish if civilian drivers reacted in an adverse driving manner when moving out of the way of a Police vehicle whilst on response. Expert B who analysed clip CD70 in detail stated that the liability for blame was with the Police driver who was in breach of their training. This would constitute a rule based mistake as graded by Reason (1990) and previously developed by Rasmussen (1980) in his taxonomy. Rasmussen (1980) described the "rule based mistake" as where the action was established as correct practise for an individual, but a subsequent inappropriate action was applied. An example of this could be where drivers were aware of the need to stop at a red traffic light but chose not to do so and proceeded. Some researchers have indicated that it is often the civilian driver who makes a mistake or error (Shultz et al. 2009; Clarke et al. 2009) as the Police driver has received a higher level of driver training (Dorn et al. 2005). It is however also entirely possible for a Police driver to make mistakes regardless of their training. Human or driver error has previously been

identified as a large contributory factor in road crashes with Treat (1980) estimating human factors as definite causes in 70.7% of incidents. Similar results were reported by Sabey et al. (1980) with 65% of crashes attributed directly to the road user. In both studies, other factors were assigned to the environment and vehicle. It was recognised by Treat (1980) and Sabey et al. (1980) that there will often be several factors at play which influence the outcome but Reason, Manstead, Stradling, Baxter and Campbell (1990) stated that errors were related to an individual's cognitive processing rather than skill. The Police driver in the reviewed clip would have been aware of the correct driving procedures but has chosen, for a yet unidentified reason to drive in a different manner as suggested by the expert review.

There are several possible reasons for the apportioning of blame by Expert B towards the Police driver. Crundall et al. (2003) considered the difference in eye scanning between pursuit and response drivers. Clip referenced CD70 was considered to a response drive as the Police vehicles were driving to a call, using emergency warning systems and higher speeds. This is compared to a pursuit drive where the speed and warning systems may still be operational, but the drivers are directly following a suspect or fleeing vehicle, for which in this clip there was no evidence of such a target. Based on Crundall et al. (2003) the driver would have been more likely to have short fixation durations and better horizontal eye scanning than their pursuit counterpart. They found that Police drivers were more likely to rely on their peripheral vision whilst trying to compensate for the increased visual salience ahead. Interestingly in this clip there was a first Police vehicle ahead which could have caused an increased focus for the driver. This would fit with Crundall et al's (2003) study which found that at night due to other objects being less salient it increased the salience of the central vehicle, albeit in their research a fleeing vehicle. The amount of information needed to be processed will be high for a response driver and will need the driver to detect, identify, plan and react to a hazard, all of which need time (Cook et al. 2011). Whilst the Police driver may have used their peripheral vision, they had passed several civilian drivers in the left lane without incident at significant speed. The civilian car in question however indicated just three times to move out but due to the speed of the Police vehicle, the Police driver left himself little time to react.

Police drivers are clearly required to use high speeds to carry out their role as Roads Policing officers, but it was previously noted in Chapter 2 with the literature review that drivers consider themselves to be better than the average driver as they view themselves as more highly skilled (Svenson, 1981). Dorn et al. (2003) observed that this illusionary sense of control can have the effect of creating negative attitudes towards other road users and reduce information processing resources previously described as “red mist”. Dorn et al. (2003) further observed that this sense of control can have higher consequences for the Police drivers due to their speeds, and the possible disregarding of traffic rules.

A further potential reason for the Police driver error could be explained by secondary distractions. The literature review explored how mental workload could affect an individual leading to a performance reduction. Wickens (1980) observed that there was a finite pool of resources and the driving of a police vehicle under emergency conditions placed demands on perception and cognition, alongside auditory and visual modalities. The instrument panel and auxiliary controls such as the specific Police controls (Figures 6.2 and 6.3) may require attention during the drive from deciding when to use through moving a gaze to the controls and the physical process of switching them on or off. Wierwille, Husle, Fischer and Dingus (1991) observed that if a driver could gain the information, they needed within one second, they would return their view to the road ahead. Any duration longer than 1.5 seconds would mean the driver would return their gaze ahead and gather the information later having been unsuccessful at that time. Later research by Nieminen and Summala (1994) found that there was no difference in time spent on secondary tasks when allowing for experience. For a driver who was travelling at 128mph with limited visibility ahead (as in the case above) this secondary attention could result in a significant distance travelled whilst not fully attending to their forward vision. The demands placed on Police drivers such as for communication and time planning was noted by Gandolfi et al. (2003) who found that it could lead to reduced concentration and increased risk taking and may provide an insight into the Police error in this case. It is equally possible that there was an increase in demand on the civilian driver, but this could not be observed from the naturalistic data due to the external nature of the police vehicle camera. It is possible that the civilian was engaged in another task or was affected by

the road monotony (Paxion et al. 2014) which is known to affect visual scanning and mirror check frequency (Recartes et al. 2000).

For this case whilst there are several explanations for the Police driver error, and the initial civilian driver action which are considered further in the discussion. Data was gathered anonymously so neither driver could be identified for interview. Additionally, footage is only forward facing so a view of the Police driver was not available.

The final event captured within Photos 6.21 (1 – 7) involved a Heavy Goods Vehicle (HGV) which had to brake hard as a result of being inadvertently caught up in a Police operation to stop another vehicle in a Tactical Pursuit and Containment (TPAC) manoeuvre. This clip was again also subsequently reviewed by a Police Driving expert (Expert B) to establish if the Police driver had executed the manoeuvre correctly.

***"17/10/2015. Tactical Pursuit and Containment (TPAC) operation on the M4. 12:47 pm.***

*This incident displays TPAC units making ground to assist a covert operation in the tactical stopping of a suspect car. This was an intelligence led operation and the tactic being deployed was a pre-emptive box.*

*It was evident that the Officers were liaising with a covert unit so would have been aware of the suspect vehicle location and its intended route. Officers would have put in place a tactical plan to stop the vehicle and apprehend the suspect. The general driving is conformist with the level of driver training.*

*My concern however is the point of delivery of the tactic. You can see clearly from the in-car video that the tactic was deployed immediately in front of a Large Goods vehicle, causing an emergency stop of that vehicle. This is evidenced by the tyre smoke emanating from it.*

*To rationalise the decision making for the deployment of the tactic, there must be a radio link between the 3 Police cars. Officers are trained to seek out suitable and safe locations for this, especially when engaged on operations, where the public may come into conflict with the operation. Therefore, the driver of the lead car would have been making the risk based decision to call the following car up to*

deploy. At that critical time a risk based decision is made which must consider the above statement. Once the following cars are called up it's a statement from them that deployment is to occur. The driver of the rear car must then carry out a risk assessment of the following public before calling that safety is on and it's ok to continue.

In this case the proximity of the HGV was not effectively catered for, with a serious collision only narrowly being avoided by the actions of the HGV driver. One must ask oneself why they didn't wait for the suspect car to create a bigger gap or even the rear Police car to notify the others of the HGVs proximity. Delaying the tactic would have been a more appropriate action."



1



2



3



4



5



6



7

**Figure 6.21 (1-7): Sequence of events immediately prior to the execution of the TPAC manoeuvre (CD67)**

The clip CD67 differs from CD70 as the manoeuvre was considered poorly executed, by the expert reviewer, as a collective group compared to a single officer making a mistake. Each officer is required to undergo specific training to be able to be able to complete a TPAC manoeuvre which forms part of their overall Advanced Police driving authorisation. All vehicles were marked high performance BMW's in line with the College of Policing regulations. The drivers were observed gathering some distance away in preparation to start their drive towards the target vehicle indicating the operation was pre-planned. The initial speeds were high in relation to the conditions as all vehicles reached speeds in excess of 30mph despite approaching a roundabout. The drive itself took approximately 15 minutes with the vehicles reaching speeds up to 128mph on the Motorway, where traffic was light and weather overcast. The Police cars travelled approximately 30 miles in total.

The Police vehicles were all travelling in close proximity and would have required the drivers to be focussed with a high level of concentration during that time. Ben Zur et

al. (1980) found that high levels of pressure can increase feelings of stress which would in turn narrow field of vision. Hoyos (1988) applied the Transactional Model of Driver Stress (Matthews, 2002) (Figure 2.14) to hazardous driving conditions and found that increases in stress was determined by both the strength of the demand and the duration. Hoyos (1988) noted that the longer a stress factor was present then the greater the stress experienced by the driver and Crundall et al. (2003) considered the effect this may have on a Police pursuit driver. The researchers noted that Hoyos' (1988) work could apply where there were high speeds, close following, additional mental load of communication, decision making, and unconventional driving manoeuvres.

A factor that may further affect the driver's attention could be the influence of "time on task" (Oz et al. 2007). Where the task is prolonged the ability of an individual to maintain their performance levels can become increasingly difficult (Hulst, Meijman, Rothengatter (2001). Later research by Oz et al. (2010) also referenced the Transactional model whereby the environmental factors from a high workload influence the cognitive stress processes which in turn can lead to negative performance outcomes such as risk taking. The opinion and review by Expert B for this clip illustrates the published literature findings. Whilst this drive (CD67) did not commence as a pursuit, TPAC is considered a pursuit tactic by the College of Policing (College of Policing<sup>19</sup>) and its characteristics can be applied to the Hoyos (1988) research. The conditions are applicable to the situation as there would have been a lead vehicle providing instructions to the other vehicles over a radio. Crundall et al. (2003) observed that the factors would influence driver attention with later research by Crundall et al. (2005) observing that for a response drive whilst there was no fleeing vehicle, it still involved high speed and some contravention of road legislation. The conditions a pursuit driver may have to contend with regarding speed, communication and close following would require drivers to have a greater visual search pattern but a dangerous hazard appearing (e.g. a target vehicle) will concentrate attention to one focus, although Crundall et al. (2005) also noted that a response driver still focused with a narrow spread of search. A TPAC manoeuvre holds characteristics of both pursuit and response drives as shown which arguably makes it unique for a driver.

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<sup>19</sup> College of Policing Pursuit Management [Online] <https://www.app.college.police.uk/app-content/road-policing-2/police-pursuits/?highlight=pursuits?s=pursuits#red-mist>

Throughout the drive the Police vehicles were seen to operate their rear lights periodically but whilst this may have proved to be a temporary secondary distraction it would not explain the collective mistake made by the officers when deliberately stopping the target. The Literature review also discussed how the design of commercial type vehicles such as HGV's and vans could limit a driver's vision created from blind spots (Marshall et al. 2017) and the Police vehicles may have taken advantage of this knowledge in order to stay relatively discreet when they were approaching their target. The Police vehicles, as a result would have not been as visible to the HGV driver potentially for a reasonable duration in order to allow him to stop safely and in a reasonable period (Missikpode et al. 2018). The driver of the HGV could also not have been expected to predict the upcoming Police manoeuvre even if they had observed the approaching vehicles. The target vehicle was immediately in front of the HGV and the Police drivers utilised the vehicle size and its ability to restrict vision (Hsiao et al. 2018). The Police drivers appear to have been fully focussed on their target at the expense of other road users. However, the College of Policing (College of Policing<sup>20</sup>) notes that drivers must manage emotional factors during a pursuit to avoid becoming so focussed on an object that their ability to assess driving risk becomes reduced. Whilst it is not possible to interview the officers, narrowing of attention to one point of focus appears to be the most likely explanation in this case.

### **6.5.2.ii Marked Vehicles – Data collected from dashcam**

The second method of collection for video data from a marked Police vehicle was a dashcam mounted on the front windscreen, with data stored on SD Memory cards.

Total number of clips	281
Total footage time	9hr, 59min, 7sec
Total "Blue Light" footage time	1hr, 43min, 39sec

**Table 6.7: Total footage for marked Police vehicles from Dashcam**

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<sup>20</sup> College of Policing *Road Policing. Police pursuits.* [Online]  
<https://www.app.college.Police.uk/app-content/road-policing-2/Police-pursuits/>



**Figure 6.22: Marked Police vehicle Dashcam data analysis**

The use of the dashcam provided the richest data in both volume and events. 55 clips were established as emergency response (Figure 6.22) with 21 of those considered to contain adverse events. The remaining 226 were discarded as they were found to be non-emergency drives.

#### *Adverse Dashcam Marked incidents*

Following the initial screening of the clips to establish whether they were emergency response and then subsequently found to contain any possible adverse driving, the clips were reviewed externally. The experts again reviewed the clips which had been screened to establish the correct category in line with Reason's taxonomy.

Clip Ref	Total footage	Total Blue Light footage	Vehicle Type	Description of adverse event	Time and location filming occurred	Error Type
	Duration (sec)	Duration (sec)				
BL5	61	61	Van	Figure 6.23 Van does not notice for 25 seconds before moving over	08:44 M'Way	Civilian Lapse
BL9	61	61	HGV	Figure 6.24 Lorry did not move for 10s despite PV using horn to get attention	08:48 Dual	Civilian Lapse
BL17	181	181	Car	Figure 6.25 One vehicle moved late on slip road – caused a 2s delay and pushed	11:49 Urban / M'Way	Civilian Routine Violation

				onto hard shoulder (@50s in clip).		
					Police	
				<b>Figure 6.26</b> Police Vehicle crossed solid hatched area in order to move to main carriageway early. No obstruction ahead.	Routine	Violation
BL18	181	107	Van	<b>Figure 6.27</b> Van did not notice for 11s Dual before moving to Lane 1	Civilian	Lapse
BL21	61	61	Van	<b>Figure 6.28</b> Van did not move for 8 M'Way seconds	Civilian	Lapse
BL24	61	61	Car	<b>Figure 6.29</b> Vehicle in Lane 3 did not react M'Way for 8 seconds even though Lane 2 was clear	Civilian	Lapse
BL29	61	61	4x4	<b>Figure 6.30/6.31</b> PV tried to move past Dual traffic. PV moved into Roadworks area to pass on the left but 4x4 did the same	Civilian	knowledge based Mistake, Police rule based Mistake
BL31	301	128	Car	<b>Figure 6.32</b> Vehicles parted at traffic lights. PV positioned to go through centre of two lanes. 184 s into clip 1 vehicle on the pavement.	Civilian	Routine violation
BL33	301	301	Car	<b>Figure 6.33</b> @146s on clip: Queue at traffic lights. Vehicles undecided which way to move.	Civilian	Knowledge based Mistake
			Car	Vehicles also crossed line at Traffic lights	Civilian	Routine
					Civilian	Violation

BL37	301	76	Car	<p><b>Figure 6.34</b> Vehicle mounted pavement to move to RH side as PV also travelled up the right (298s into clip)</p>	12:55	Civilian Routine violation
BL41	301	231	Car	<p><b>1. Figure 6.35</b> Car in Lane 3 (filter lane mounted grass on RHS into clip.</p>	20:11	Civilian Routine Violation
				<p><b>2. Figure 6.36</b> 2<sup>nd</sup> Civilian vehicle on crossroads very hesitant. Green Traffic lights for civilian, PV on Red.</p>		Civilian Knowledge based Mistake
BL43	301	116	Car	<p><b>Figure 6.37</b> Car stopped at Junction on green light. Vehicle in RH lane also stopped which caused an obstruction.</p>	20:25	Civilian Knowledge based mistake
BL44	301	301	Car	<p><b>1. Figure 6.38</b> Car crossed Red light into Box junction and blocked part of road for oncoming traffic.</p>	20:30	Civilian Routine violation
				<p><b>2. Figure 6.39</b> Taxi pulled out and obstructed traffic causing delay of 23s. (Wales 27-23 Scotland   Six Nations   13 Feb 2016)</p>		Civilian Knowledge based mistake
BL46	301	301	Coach	<p><b>Heavy Traffic.</b> City Dual C'way.</p>	20:40	
				<p><b>1. Figure 6.40</b> Coach mounts pavement next to bus stop and petrol station to make space.</p>		1.Civilian Routine violation

			Car	2. <a href="#">Figure 6.41</a> Vehicle on RH lane mounts a very high kerb	2. Civilian Routine violation
			Car	3. <a href="#">Figure 6.42</a> 2 <sup>nd</sup> small coach mounts pavement	3. Civilian Routine violation
			Car	4. <a href="#">Figure 6.43</a> 2 Vehicles cross over red traffic lights to make space	4. Civilian Routine violation
BL50	301	110	Van	1 <a href="#">Figure 6.44, 6.45</a> Van crossed line at red traffic light to move out of the way	Civilian Routine Violation

**Table 6.8: Summary of adverse events from marked Police vehicles using dashcam**

The data collected from the ANPR camera allowed the vehicle speed to be observed on the footage. However, the dashcam did not contain such a facility and therefore the information was unavailable for Table 6.8.

6 events were again identified on a National Speed Limit road during daylight, where civilian drivers did not observe the impending Police vehicle and therefore the civilian delayed the Police vehicle. One driver (taxi) failed to observe “blue lights” in a tunnel and pulled out from a side road causing a lengthy delay. In all other cases vehicles were attempting to move out of the way but in order to do so, committed moving traffic offences in 10 cases, whilst 3 drivers showed hesitation in knowing where to move to. Except for the first 6 events these were all observed in urban areas and resulted in the driving “error” categorisations summarised in Table 6.9.

Two further events were apportioned to Police fault by the experts - one was considered a rule-based violation where the Police driver crossed a solid hatched area (Figure 6.26) and the second where the Police vehicle displayed hesitation (rule-based mistake) before moving into roadworks. This put the maintenance vehicle and personnel at risk (Figure 6.31). The reasons for these errors are considered further in the discussion.

Driving Errors	Civilian Error category	Police Error category	No of incidents recorded (Civilian)	No of incidents recorded (Police)	Photo reference
Delayed reaction	Lapse	-	5	-	6.23, 6.24, 6.27, 6.28, 6.29
Mounting the pavement	Routine Violation	-	5	-	6.34, 6.35, 6.40, 6.41, 6.42
Passing a Red Traffic Light	Routine Violation	-	4	-	6.32, 6.33, 6.43, 6.44/ 6.45
Displaying hesitation	Knowledge based Mistake	Rule based Mistake	1	1	6.31, 6.36
Causing an obstruction assisting the Police vehicle passage	Knowledge based Mistake	-	3	-	6.30, 6.37, 6.39
Driving on a Hard shoulder	Routine Violation		1	-	6.25
Obstructing a Box Junction	Routine Violation	-	1	-	6.38
Solid hatched area		Rule based violation	-	1	6.26
<b>Total</b>			<b>20</b>	<b>2</b>	

Table 6.9: Types of driving errors identified from marked Police vehicle dashcam



**Figure 6.23: Marked Police vehicle delayed by 25s with Van ahead (BL5)**



**Figure 6.24: Marked Police vehicle delayed by 10s with HGV ahead (BL9)**



**Figure 6.25: Car entered hard shoulder (BL17)**



**Figure 6.26: Police driver entering solid hatched area (BL17)**



**Figure 6.27: Van ahead of rear approaching marked Police vehicle (BL18)**



**Figure 6.28: Van ahead of rear approaching marked Police vehicle (BL21)**



**Figure 6.29: Car ahead of rear approaching marked Police vehicle (BL24)**



**Figure 6.30: 4x4 attempted to make a clear passage but caused an obstruction (BL29)**



**Figure 6.31: Police vehicle attempting to pass though roadworks area (BL29)**



**Figure 6.32: Vehicles attempted to make a clear passage by mounting the pavement (BL31)**



**Figure 6.33: Vehicles attempted to make a clear passage (BL33)**



**Figure 6.34: Vehicles attempted to make a clear passage by mounting the pavement (BL37)**



**Figure 6.35: Vehicles attempted to make a clear passage by mounting the pavement (BL41/1)**



**Figure 6.36: Vehicles attempted to make a clear passage but hesitated in a box junction (BL41/2)**

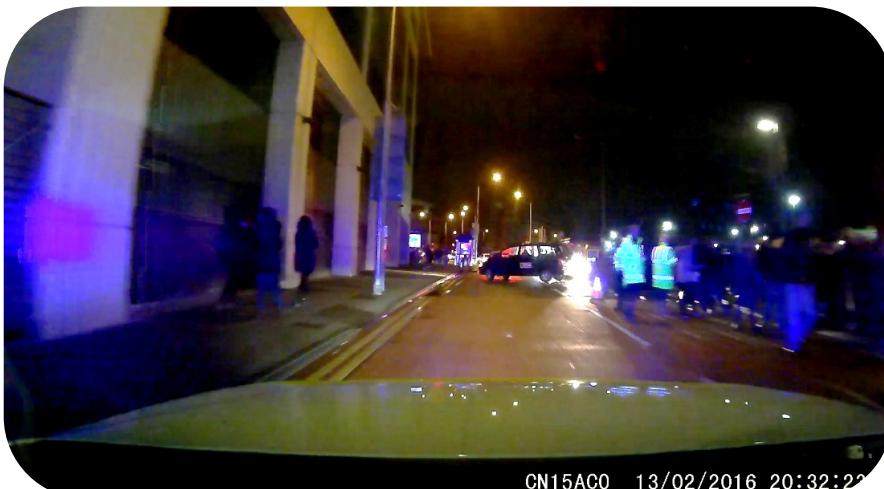


**Figure 6.37: Vehicles attempted to make a clear passage by passing through a red light (BL43)**



CN15AC0 13/02/2016 20:31

Figure 6.38: Vehicles attempted to make a clear passage resulting in an obstruction (BL44/1)



CN15AC0 13/02/2016 20:32:22

Figure 6.39: Taxi pulled out in front of the Police car causing an obstruction (BL44/2)



CN15AC0 13/02/2016 20:40:22

Figure 6.40: Vehicles attempted to make a clear passage by mounting the pavement (BL46/1)



Figure 6.41: Vehicles attempted to make a clear passage by mounting the pavement (BL46/2)



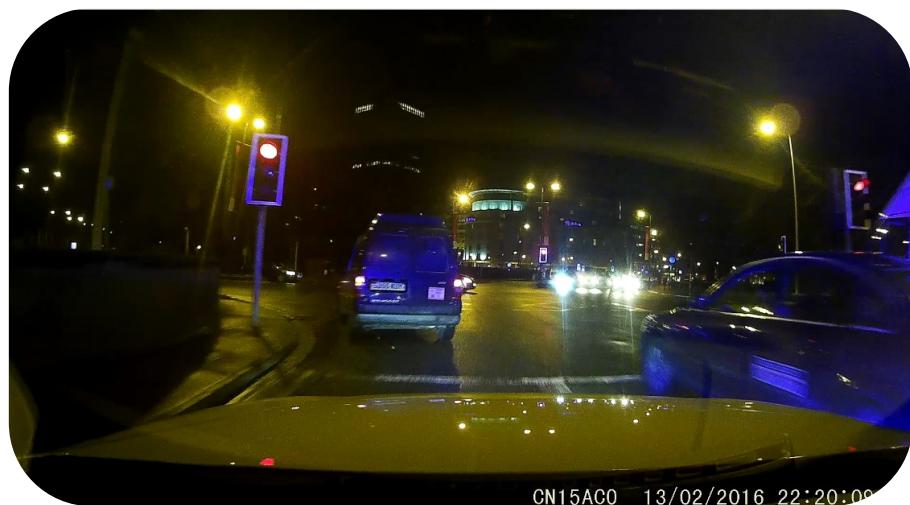
Figure 6.42: Coach attempted to make a clear passage by mounting the pavement (BL46/3)



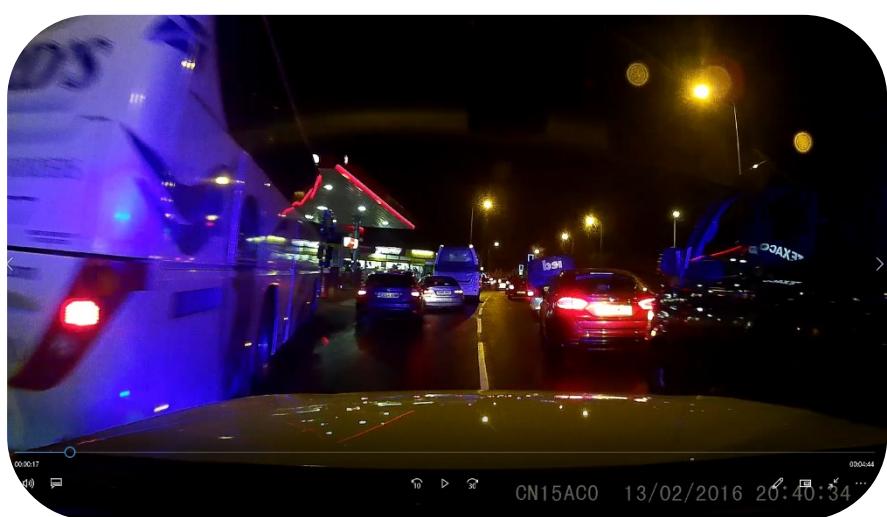
Figure 6.43: Vehicles attempted to make a clear passage by proceeding through a red light (BL46/4)



**Figure 6.44: Vehicles making clear passage with traffic camera on the left (BL500)**



**Figure 6.45: Vehicles attempted to make a clear passage by proceeding through red light (BL50)**



**Figure 6.46: Police vehicle making progress through narrow gap (BL50)**

### 6.5.3 Sentiment Analysis

To provide a balanced and expert view on the actions of both the Police driver and civilian driver, three Police Driver Training Managers, Expert A, B and C were asked to review the footage. This was following an initial screening by the researcher to establish if there were any driving occurrences requiring analysis. Each reviewed the same clip independently of each other to avoid a biased response. The Police ANPR and dashcam clips were selected alternatively based on their file referencing and were split according to road type and urban type to ensure equality in comparison. The clips reviewed and opinion recorded were BL05, BGL17, BL21, BL29, CD56, BL31, BL37, BL43, BL46, CD25 and CD28 with the last two relating to footage gathered from unmarked Police Vehicles. All comments made by the experts were recorded and later transcribed in to written text. The full transcript can be found in Appendix 18.

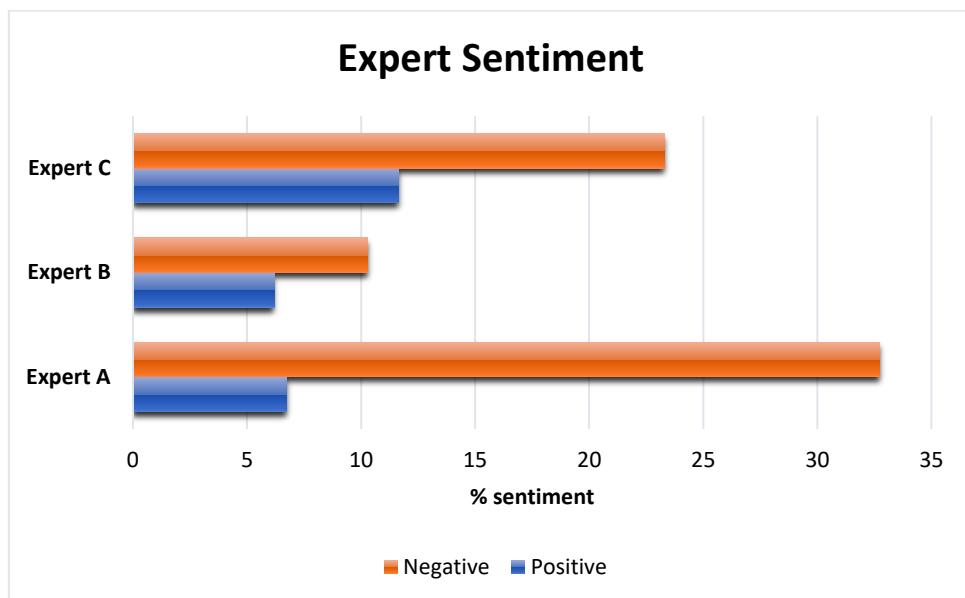
It was considered appropriate to analyse the text content using an independent tool which was able to extract the sentiment polarity (positive and negative) from the comments in accordance with the recommended practice for inter-rater reliability. Several research papers have found that small data volumes such as those in small extracts on Twitter or Facebook can be reviewed for sentimentality (Bhuta, Doshi, Doshi, Narvekar, 2014) but manual coding can be challenging due to limited contextual information (Ochieng, Loki, Sambuli, 2016). It was decided that the information gathered from the experts should initially be auto-coded and analysed by thematic software to establish if there were any trends in sentiment and to avoid bias. The review tool was NVivo v11 which is a qualitative data analysis computer software package, and which provided a deeper independent analysis of text data to find possible data links. Ochieng et al. (2016) considered the limitations of small data and suggested that in order to improve the effectiveness of the analysis the sentiment analysis results should be paired with human analysis to examine contextual detail.

The data was processed to establish if each of the experts expressed similar sentiments following a review of the footage (Table 6.10).

Sentiment	Very Negative	Moderately negative	Moderately Positive	Very positive
Expert A	6	8	1	1
Expert B	2	2	1	0
Expert C	5	11	9	0

**Table 6.10: Summary of expert sentiment frequency**

A review of the expert responses found that Expert A was the most negative of the driving they observed with Expert C referencing the most positive sentiments (Figure 6.47).

**Figure 6.47: Expert sentiments by positivity**

A breakdown of each of the sentiment sections from Table 6.10 was then conducted to determine the exact references (Table 6.11 below). There were several negative observations made regarding the driving standards of the Police Vehicle which included “aggressive”, “pushy” and “pressured”. The civilian drivers’ conduct was also reviewed by the experts, and issues were raised regarding observations and decision making. The civilian drivers’ conduct was viewed as mainly positively with inferences that some of the actions they took were forced upon them by the poor driving by the Police drivers.

	<b>Very negative</b>	
Expert	Text reference	Data reference
A	The Police Vehicle is very aggressive in his manner of driving.	BL17
A	It was not an unsafe move as it was slow speed but could cause damage to the tyres.	BL31
A	At the traffic lights the driver was being helpful but was clearly pressured by the Police driver who was displaying a high level of overconfidence.	BL43
A	Very pushy Police driver.	BL46
A	This may explain the very poorly executed TPAC manoeuvre.	CD67
A	but is quite close behind and is probably in the Motorhomes blind spot.	CD25
B	I think the driving from the public is fine, but the Police driver is overly aggressive to get the Van to move out of the way.	BL37
B	Overly aggressive driving which may cause the public to make a wrong decision.	CD28
C	Despite this they are trying to make space but risk damaging their cars.	BL46
C	There were no occasions where the public were unaware that there was a Police car behind and whilst they are trying to move over in the space available the Police driver is being very aggressive in trying to get through before it is probably safe.	BL46
C	It is not possible to establish why the van took so long as there was a curve in the road so checking the left hand mirror would have aided the van driver who otherwise may have had restricted vision	CD56
C	However, the TPAC was very badly initiated as they forced an HGV to stop abruptly and road dust can be seen coming from the wheels.	CD67
C	However, the car immediately in front has failed to notice the Police car and stayed in the same lane for around 8 seconds.	CD28

	<b>Moderately negative</b>	
Expert	Text reference	Data reference
A	They were put under pressure due to the Police Vehicles speed as he was approaching from behind.	BL17
A	The Police Vehicle was approaching the junction and forced the drivers on to the pavements so gave them little choice.	BL37
A	Police driver was too aggressive and should have held back and waited if there is no clear way through.	BL46
A	The Police Vehicle is consistently pressuring drivers into having to do something which is risky for causing damage.	BL46

A	The Van driver was very late in reacting on a clear road, but it is not possible to speculate as to why that was the case.	CD56
A	The Van driver was delayed in moving by 6 – 7 seconds with good visibility but did not see the Police Vehicle.	BL37
A	The Police vehicle is impeded by a Motorhome for several seconds which has not seen it approaching from behind.	CD25
A	Several cars appear to have seen the approaching vehicle and have moved across although one car, a Corsa did not immediately see it and caused the Police Vehicle to reduce their speed to around 90mph.	CD28
B	The public therefore have to take evasive action.	BL17
B	The Police Vehicle was too quick approaching the car on the left.	CD25
C	The van delay is unacceptable, but the Police driver could have helped by varying their lane position a little more.	BL5
C	The Police driver whilst responding seems to be a little aggressive in their overall approach.	BL17
C	This slowed the Police driver and is too long for the Van driver.	BL21
C	It is not possible to know what emergency they were attending but I would question if this manoeuvre was worth the time saving.	BL29
C	They have made a number of manoeuvres which I believe are risky considering the amount of information that is needed to be processed.	BL43
C	Unfortunately, there is a pavement on the left with a lot of street furniture and a high kerb to the right with a barrier.	BL46
C	The Police driver was not too close at any point so unlikely to be in their blind spot.	CD56
C	The delay from the Motorhome whilst too long was compounded by the distance the unmarked car then sat behind.	CD25
C	Considering the speed and the fact the Motorhome is a large wide vehicle they would have found it very difficult to know there was a Police vehicle behind them and certainly would not have been able to see the covert lighting.	CD25
C	This may be because the car behind them was quite close or the driver has seen the approaching Police vehicle, but it is not possible to clarify this	CD28
C	This is too long and suggests the driver was not checking their mirrors, but it is not possible to speculate as to why they were not.	CD28

<b>Moderately positive</b>		
Expert	Text reference	Data reference
A	Failure to use their mirrors caused the delay as the vehicle size is not prohibitive from the civilian point of view, even if the Police Vehicle is unmarked.	CD28

<b>Very positive</b>		
Expert	Text reference	Data reference
A	At the traffic lights the driver was being helpful but was clearly pressured by the Police driver who was displaying a high level of overconfidence.	BL43
B	If the Police Vehicle is too close and the headlights are flashing the Van driver may not see the lights in the mirror, but he needs to be checking earlier anyway and on a more regular basis.	BL21
C	It looks a little overcast, but the visibility seems ok.	BL5
C	Even after the 10 seconds it took for the Police vehicle to reach them the van still has not moved over into the clear space available.	BL5
C	This forces the car far to the left and essentially on the hard shoulder.	BL17
C	It is not possible to know what emergency they were attending but I would question if this manoeuvre was worth the time saving.	BL29
C	There is a large white van ahead (Citroen Relay) which did not move for 11 seconds but did have the opportunity to do so.	BL37
C	However, for the conditions the Police seem to be travelling too fast.	BL43
C	There were no occasions where the public were unaware that there was a Police car behind and whilst they are trying to move over in the space available the Police driver is being very aggressive in trying to get through before it is probably safe.	BL46
C	Considering it was unmarked this however was not a problem as there was little traffic.	CD28
C	This may be because the car behind them was quite close or the driver has not seen the approaching Police vehicle, but it is not possible to clarify this.	CD28

Table 6.11: NVivo descriptive by sentiment

There was agreement by the experts that the delay demonstrated by some civilian drivers was outside what could be deemed acceptable. The experts agreed that

between 3 - 5 seconds would be a reasonable reaction time for a driver response to the presence of a Police vehicle on emergency response. The experts confirmed that the conditions were good, and the civilian drivers had enough opportunity to move across to another lane. The literature review considered reaction times from a research perspective and whilst no one single time could be established, a delay of 2.5 seconds appeared to be the maximum normal expectation (Triggs et al. 1982; Taoka, 1989).

It was noted by the experts that some of the vehicles themselves, through their design and size, may have impeded a driver's opportunity to observe the Police Vehicle. The Police Vehicle can be observed approaching behind vehicle types such as a Motorhome (Figure 6.48), HGV (Figure 6.49) and long wheel-based van (Figure 6.50).



Figure 6.48: Motorhome ahead of responding Police vehicle (CD25)



Figure 6.49: HGV ahead of responding Police vehicle (BL9)



Figure 6.50: Van ahead of responding Police vehicle (BL18)

The vehicle design could potentially restrict the civilian driver from seeing the Police vehicle due to blind spots and limited rear visibility as discussed in the literature review and illustrated in Figures 2.20 and 2.22. However, the Police Vehicle did not move their position left or right to increase the opportunity to be observed in the van mirrors.

Expert B commented that *“If the Police Vehicle is too close and the headlights are flashing the Van driver may not see the lights in the mirror, but he/she needs to be checking earlier anyway and on a more regular basis.”* (BL21). They also observed that *“The Van driver has not noticed the Police Vehicle and the Officer should have used his/her position better. The late observation could be, in part, due to the size of the vehicle but Police drivers are trained to realise this.”* (BL5).

Additionally, due to the speed that the Police Vehicle was travelling, recorded on the ANPR as 120 miles an hour it would have covered approximately 60 metres a second. If a driver was checking mirrors every 10 seconds, as noted by Expert B, then the Police Vehicle would have to be at least 600 metres away to be seen. If other vehicles were following in the same lane for some of that time, then it is possible the driver would not be able to see the Police vehicle. This may be due to their view being partially blocked, and the fact it was an unmarked Police vehicle, where emergency lighting was fitted in the front grille. However, this view was contradicted by Expert A who stated that *“There was no visual reaction to the strobe lights even though it was a straight road and the Police Vehicle would have been visible from some distance away. They would have had 10 – 12 seconds to react.”* (BL5)

Despite vehicle design issues, Expert A also observed that “*the van driver is not searching his/her mirrors. The Van driver is distracted as he/she has not gathered the information and then instinctively brakes when he/she does notice the Police Vehicle behind. We can only hypothesise as to why he/she is not checking.*” (BL17)

The Experts reviewed the clips and agreed with the original analysis that any delayed reactions occurred on high speed roads and moving over appropriately (or inappropriately) occurred more frequently in urban areas where there are greater numbers of (e.g.) parked vehicles or street furniture. For high speed roads on initial review of the footage it would be easy to blame the civilian driver for poor awareness or observations as they were considered to have reacted late. However, the driver may have been distracted in some way, causing a lack of mirror checks and the reasons for the delayed reaction could be numerous, as suggested from the literature review. The experts noted that where the civilian vehicle was larger such as a van or motorhome then the Police Vehicle could have repositioned in the lane to ensure they were visible to the drivers within the mirrors due to limited rear vision.

Several of the clips involved a driver response within an urban environment. The experts did not apportion blame on the civilian driver for poor decision making. However, several comments were made which referred to the actions of the Police driver. The Experts believed that the Police driver was pushy and overly aggressive which forced the civilian driver into making poor positioning decisions or performing poorly executed manoeuvres.

The results of this analysis suggest that the Police drivers can in part be blamed for the actions that the civilian driver takes through being overly aggressive in their driving manner as opposed to holding back for a short time. Four clip reviews included the term “aggressive” by the experts. Several references are made to the civilian drivers having a lack of time, caused by the driving of the Police Vehicle and therefore forcing them into a rushed manoeuvre.

#### 6.5.4 Summary of data collected

For both marked and unmarked Police vehicle events, the most frequently occurring negative behaviour was a civilian driver failing to notice an approaching Police vehicle in broad daylight on a National Speed Limit road with the emergency warning systems in operation. This accounted for 12 (37.5%) of the total 32 events identified and were deemed a “lapse” within the taxonomy. Whilst civilian driver’s avoidance manoeuvres included mounting the pavement and crossing a red traffic light, these were seemingly done with good intentions by the driver. However, all constitute a driving violation – a deliberate breach of the regulated code of behaviour (Parker, Reason, Manstead and Stradling, 1995) which under some circumstances could result in prosecution. One violation (BL50 – Figures 6.44 – 6.45) was observed where the driver crossed at a red traffic light despite the presence of a traffic enforcement camera.

Adverse Event	Unmarked (ANPR)	Marked (ANPR)	Marked (Dashcam)	Total Identified events	Road type
Failure to notice (Lapse)	3	4	5	12	Dual/ M'Way
Mounting the pavement (Routine violation)	-	-	5	5	Urban
Crossing a red traffic light (Routine violation)	-	-	4	4	Urban
Hesitation in a Box Junction (Knowledge based mistake)	-	-	1	1	Urban
Hesitation (Knowledge based – civilian, Rule based – Police)			2	2	Urban
Obstruction at junctions (Knowledge based mistake)	-	-	3	3	Urban
Using a hard shoulder (Routine violation)	-	-	1	1	M'Way
Crossed solid hatched area	-	-	1	1	Dual

Police TPAC manoeuvre (Rule based mistake)	-	1	-	1	M'Way
Police (Rule Based Mistake) and Civilian Near Miss (Lapse)	-	2	-	2	Dual
Total	3	7	22	32	

**Table 6.12: Summary of identified adverse driving behaviours**

The Road Traffic Regulation Act (1984) and the Traffic Signs Regulations and General Directions (2016) allows exemption to emergency vehicles from complying with traffic lights, providing this action can later be justified. However, such exemptions do not apply to civilian drivers. The College of Policing (College of Policing<sup>21</sup>) advise that “*When exercising the exemption to pass a red traffic light, drivers of emergency response vehicles should avoid causing a member of the public to contravene the red light. The public do not have an exemption in law to contravene red traffic lights*”.

Police training procedure suggest “holding back” if unable to immediately proceed and if necessary, turn off the emergency warning systems until progress can be made. It is then considered a civilian driver’s decision to choose to continue.

The clips were reviewed by three independent experts and to ensure consistency between them the Cohen’s Kappa test of reliability was considered. This test was considered as it checks for consistency between coders in NVivo but in this study coding was automatically applied by the software (therefore one coder) to remove any researcher bias. Kim et al. (2016, p3) noted that “*it is imperative that analyses with more than one coder report standard reliability measures such as Cohen’s Kappa*”. It is not possible to apply the test if different authors have provided the text, so it was not possible to further check for interrater reliability other than that provided by the software itself.

<sup>21</sup> College of Policing *The Law in respect of Response driving* [Online]

<https://www.app.college.Police.uk/app-content/road-policing-2/Police-driving/#complying-with-traffic-lights>

## 6.6 Results Summary

A review of real-world driving clips by Police driving Experts, utilising Reason's taxonomy, followed extraction from Roads Policing vehicles.

Two distinct differences, according to road type, were identified in relation to how civilian drivers reacted when interacting with a responding Police vehicle. For a high speed single directional road, civilian drivers were observed delaying moving to the left, despite an emergency vehicle behind them. The delay was deemed longer than reasonably acceptable of 2.5 seconds, but once the civilian driver became aware of the Police vehicles presence, the move was conducted safely with no adverse reaction. Delays for a marked Police vehicle were between 7 and 12 seconds, and for an unmarked vehicle were reported as 8 to 10 seconds. One additional case was identified involving a small van being followed for 25 seconds before it moved across in a safe manner. The similarity in reaction times between the marked and unmarked Police vehicles suggests that there may be another reason for the delay such as driver distraction, the vehicle protecting the driver from outside sound, or vehicle size such as commercial types obscuring the rear view.

For an Urban type road, civilian drivers were observed acting in an ill-advised manner, but it was not considered dangerous or panicked. The reactions were observed for a marked Police vehicle only, as no adverse events occurred for an unmarked vehicle, and related to drivers mounting a pavement, crossing a traffic light and stopping in a box junction. The errors were deemed, by the experts to be the result of the 'forceful' actions and 'aggressive driving manner' of the Police drivers.

## Chapter 7: Self report views of civilian driver behaviour around a responding Emergency vehicle (Study 4)

### 7.1 Overview

Much of the published research uses the emergency drivers views on civilian driver reactions rather than questioning the civilian drivers themselves. Burke et al. (2001) fitted video cameras to a Fire Appliance to observe the driving of civilians unobtrusively and suggested that the civilian driver was not sure of the correct action, causing them to feel anxious and stressed. However, these reported feelings were not corroborated by the drivers themselves. Civilian drivers were observed moving to the nearest kerb, slamming on brakes or not reacting at all with this final point being attributed to lack of awareness. In general, the view held by the emergency drivers can differ from the perception held by the civilian drivers themselves as reported in the literature. For example, Gormley et al. (2008) reported that 95% of the Firefighters they questioned believed civilian drivers panicked yet earlier studies by Saunders et al. (2003) found that 91% of non – emergency drivers questioned thought they themselves drove appropriately when interacting with an emergency vehicle. Whilst a driver may feel anxious once they have seen the emergency warning systems in operation it is possible that the initial awareness of their presence may be delayed. The literature review discussed the conspicuity surrounding an emergency vehicle against a cluttered background (Hsieh et al. 2011) and the difficulty the driver of a newer vehicle may have in hearing the sirens through an insulating vehicle body (De Lorenzo et al. 1991). The suggested adverse reaction by a civilian driver was identified by several researchers but with no substantiated evidence (Caelli et al. 1980; Gormley et al. 2008; Nakatani et al. 2009).

To address this an extensive questionnaire was created to establish the attitudes and opinions of emergency drivers from the Police, Fire and Ambulance service in respect of civilian driving behaviour around them. Part of the investigation in this thesis considered the opinions of emergency drivers towards civilian drivers and the latter's behaviour when moving out of the way of an emergency vehicle. The results can be found in chapter 4, with real world results reported in chapter 6. Therefore, this study was conducted to consider how the civilian's perceived their own driving, why they

believed they may not have immediately noticed an approaching emergency vehicle and whether they believed their subsequent response was appropriate.

## 7.2 Research Question

A questionnaire was designed to support the following research question.

**RQ8:** Do civilian drivers believe their driving action is appropriate and timely when they are required to move out of the way of a responding emergency vehicle?

## 7.3 Methodology

A questionnaire was designed with minimal number of questions to ensure maximum respondent engagement whilst also addressing the study aims. Using the Survey Monkey creation tool ([www.surveymonkey.co.uk](http://www.surveymonkey.co.uk)) the questionnaire was constructed so that it could be easily shared and returned both electronically and anonymously.

Responses to the 17 questions were required in a variety of formats. Some questions allowed respondents to enter free text, some required a selection of options already given as possible reasons for their behaviours and the third type was based on a 5-point Likert scale ranging from “not at all” to “definitely”. The Likert Scale followed the same pattern as that used within other questionnaires in this thesis to ensure consistency.

The final questionnaire can be found in Appendix 19 of which the first 9 questions are linked to background and demographics of the respondents.

The remaining eight questions focussed on the following areas of the civilians driving:

- To consider if any driver reaction was planned or rushed.
- To determine which manoeuvres were carried out by the driver, if any, in order to move out of the way.
- To evaluate the road type where this was most likely to occur.
- To consider how a driver may initially identify an approaching EV.

- To self-report how far away they believed the EV was upon initial awareness of it approaching.
- To consider the reasons why the awareness may not have happened sooner.
- To reflect the driver's feelings when they realised that the EV was approaching.
- To self-evaluate whether the driver considered that they acted in a controlled manner with appropriate action or road position.

#### **7.4 Data collection / Sampling Strategy**

In order to gain an insight into civilian driver views about their emergency vehicle interactions, consideration was given by the researcher as to who may be suitable as a generalised participant group. It was deemed important not to select from one section of the driving population due to potential response bias. These groups would have been (for example) specific age groups, occupations, certain types of vehicle, covered varying levels of mileage or drivers of vehicles on certain types of roads.

To avoid any bias the method subsequently adopted to gather data about civilian drivers was “Snowball Sampling” (sometimes referred to as Chain Referral sampling-Biernacki and Waldorf, 1981). Snowball sampling is a sampling strategy adopted in which a participant is identified by the researcher, and this participant then identifies further participants through their own networks (Robson, 2011).

Response rates have reportedly been falling over time within research in general (Baruch and Holtom, 2008) suggesting it is in part due to changing methods of communication. Whilst social networking is available globally there are still a limited number of set research standards with it being difficult to follow up participants due to anonymity, and less control over who responds but the advantage that it is cost effective and can reach a diverse group (Dusak, Yurova, and Ruppel, 2015).

Snowball sampling has been reported to provide research respondents who are diverse in terms of demographics and socio-economic status (Gosling, Vazire, Srivasta and John, 2004) but who can provide a representative view of the general population (Baltar and Brunet, 2011). Baltar et al. (2011) concluded that Social Network Sites (SNS) were a suitable method of improving representativeness when

applied to snowball sampling. Social network sites are described as “*web-based services that allow individuals to construct a public or semi-public profile within a bounded system, articulate a list of other users with whom they share a connection, and view and traverse their list of connections and those made by others within the system*” (Boyd and Ellison, 2008 p211).

The questionnaire was placed on social media platforms, namely LinkedIn and Facebook with a request for the researcher’s connections to access the form by clicking the link thereby allowing web based completion. The criteria for completion were that the respondent needed to hold a valid UK driving licence, not work for the emergency services in emergency response driving nor be a driver trainer. Permission was given by the researcher for respondents to share the links with other connections if they so wished.

Two social media platforms were selected which contained several established and existing contacts to start the chain. Both social network sites contained virtual connections attached to an individual (Hughes, Rowe, Batey and Lee, 2012) which could then be shared with others through making new contacts, or virtual messaging facilities.

It is acknowledged that different social media networks attract different users, and some may be less attractive to those who have, for example, retired. However, Facebook currently has 2.27 billion active users worldwide ([www.statista.com](http://www.statista.com)) so it is possible to disseminate information instantly both publicly and privately (Hughes et al. 2012). Equally LinkedIn has 467 million users ([www.statista.com](http://www.statista.com)) which is also providing access to a wide potential network (Dusek, Yorova and Ruppel, 2015) although it is acknowledged that this site is principally aimed at those in Business and Industry, albeit in multiple sectors. Whilst the number of users for the networks is extensive it is acknowledged that only a small proportion would respond to the questionnaire through connected personal networks (Kowald and Axhausen, 2012), and these figures simply illustrate their popularity and the methodology taken.

In order to increase an initial response rate of 67 a further posting was made on both sites after two weeks passed and this then increased by an additional 13 participants

resulting in a final data size of 80. Once it became clear after a further two weeks that the responses were not increasing, the questionnaire was closed for further participants. This allowed the data to be directly extracted using an Excel export feature into SPSS v 24.

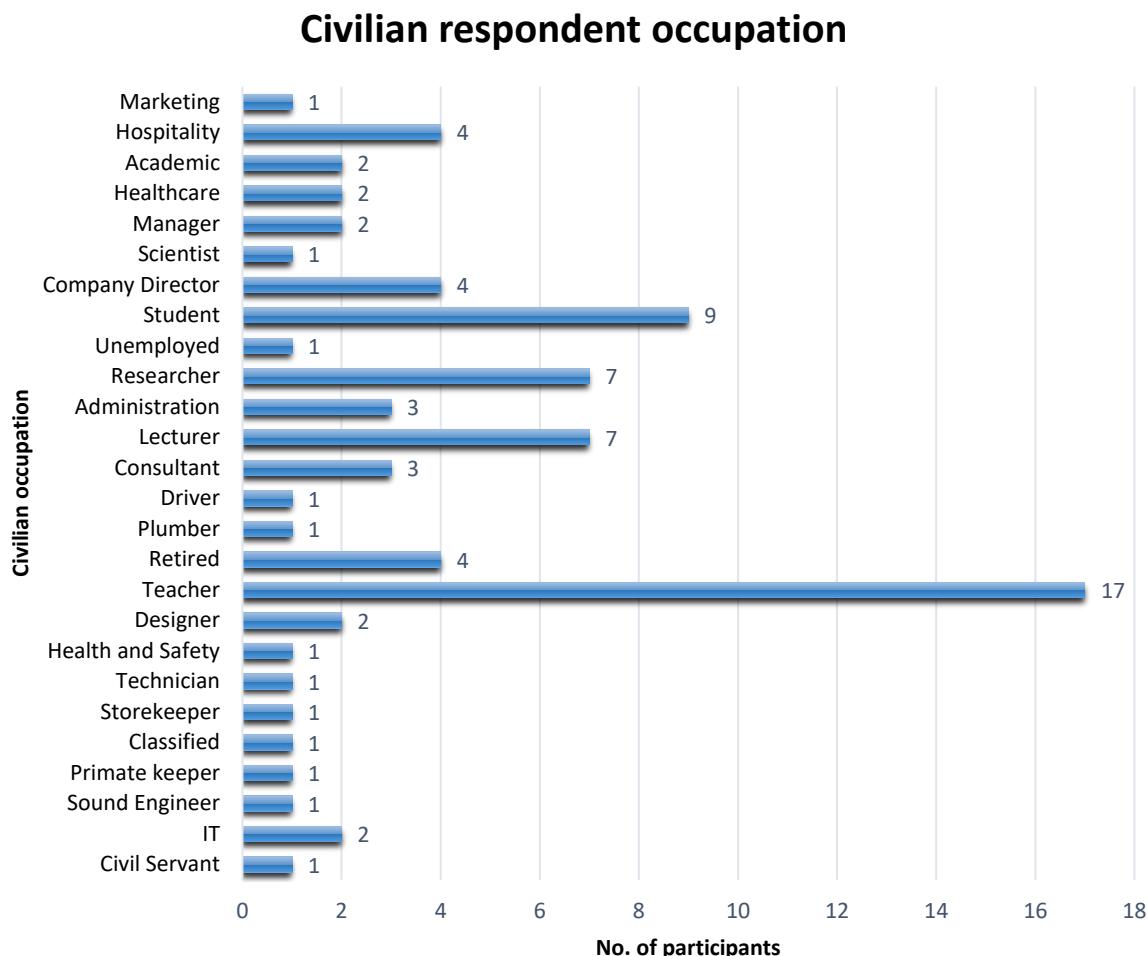
## 7.5 Participants

Initial questions focussed on driver demographics and experience to provide background and situational information on participants recruited. It was anticipated that the data would provide valuable information about civilian drivers, who interact with an emergency vehicle, according to experience and vehicle type which may give a deeper insight into their behaviour around an emergency vehicle. As a result of this method a total of 80 questionnaires were returned. Table 7.1 shows that the ages of the respondents were distributed across all categories.

	Respondents by Age group						
	18-24	25-34	35-44	45-54	55-64	65+	Total
<b>Male</b>	4	3	10	17	11	5	50
<b>Female</b>	9	7	4	6	3	1	30
<b>Total</b>	13	10	14	24	14	6	80

Table 7.1: Respondents age by gender

Those who completed the questionnaire spanned 26 differing occupations (Figure 7.1) of which “Teacher” was the highest stated occupation with 17 out of the 80 participants declaring this as their current role. Biernacki et al. (1981) identified teachers as having a high social visibility in that they are relatively easy to locate as a possible study population, but it was not the intention of this study to identify a single suitable group. Due to the collection method of snowball sampling it was accepted that this may have occurred, due to the closeness of social networks creating a selection bias (Baltar et al. 2011). In this sample the occupations were identified from the responses and were considered a representative sample of the population, as identified by Cohen (1990) who stated that snowball sampling was the best way to select users in a representative manner.



**Figure 7.1: Civilian driver occupations from questionnaire respondents**

The respondents' licence duration was analysed according to their annual declared mileage (Table 7.2) which showed that 65% had held a licence for more than 20 years, and of those, 28.8% travelled 5,000 – 10,000 miles per annum, 25% 10,000 – 15,000 miles and 19% over 20,000 miles per annum. By comparison, the average annual mileage in England was reported to be 6,747 miles per annum in 2017 (Department for Transport, 2018).

		Duration of Driving Licence							
		Less than 2 years	2 – 5 years	6 – 10 years	11 – 15 years	16 – 20 years	Over 20 years	Total	
Annual Mileage	Less than 5,000	1	2	1	1	1	4	10	
	5,000-10,000	3	3	1	1	0	15	23	
	10,000-15,000	2	2	0	2	0	13	19	
	15,000-20,000	1	2	0	1	0	7	11	
	Over 20,000	0	0	0	1	0	10	11	
	Did not answer	1	2	0	0	0	3	6	
	Total	8	11	2	6	1	52	80	

Table 7.2: Crosstabulation between Annual Mileage and Licence duration

Of the 8 drivers who had held a licence for less than 2 years, 4 were between 18 and 24 years old, 2 were 25 – 34 years old and 2 were 35 – 44 years old indicating the latter 2 groups were not all young novice drivers, but some were individuals who passed their driving test later in adulthood. It is accepted that drivers who are older, despite a lack of experience are less likely to be prone to risk taking (Quimby and Watts, 1981).

It was also previously identified in the literature that modern vehicles can mask the sound of an approaching emergency vehicle (Caelli et al. 1980; De Lorenzo et al. 1991; Balastegui et al. 2013) and as such, the age or type of vehicle being driven may provide relevance when considering how civilian drivers self – report their reaction to an emergency vehicle. Table 7.3 shows that most vehicles were cars (90%) and 88% of those were less than 10 years old suggesting they may have insulating sound properties that are associated with newer vehicle designs.

		Age of Vehicle				
		Less than 2 years	2 – 5 years	6 – 10 years	11 – 15 years	Total
Type of vehicle	Car	14	30	20	8	72
	Van	0	2	0	0	2
	Car and 4 x 4	0	0	2	0	2
	Car and Motorbike	1	0	2	1	4
	Total	15	32	24	9	80

**Table 7.3: Crosstabulation between type and age of vehicle**

## 7.6 Results

Further to the literature review about whether drivers “panic” all respondents were asked the question relating to a response to an approaching EV “*Did you need to move over quickly or was it planned?*”. Due to the word panic not having a set definition, as discussed in the literature, alongside the possibility of a subjective interpretation it was decided not to ask drivers directly if they panicked. Of the 80 responses received through completion of a free text box, 44 drivers (55%) stated that it had been planned, 25 (31.3%) reported they had moved quickly, whilst 9 (11.25%) stated that the response had involved both moving quickly and was planned. 2 drivers (2.5%) reported that the response had been unplanned. This identified that 66.25% of the respondents completed what they considered an overall planned response.

A further question was then asked for which the respondents were asked to consider if they had been required to move then what driving action had they taken.

### 7.6.i Question 10

“*If you were required to move your position have you needed to..*”

A frequency test was applied to the data as shown in Table 7.4.

<b>Manoeuvre</b>	<b>No. of responses</b>
Reverse	8
Mount a pavement	44
Cross a red traffic light	16
Move lanes	70
Move left	75
Move right	43
Speed up to move quickly	42
Stop on a pedestrian crossing	11
Other	11
	<b>320</b>

**Table 7.4: Drivers self-report manoeuvre when interacting with an EV**

Of the 80 driver participants, 75 drivers reported having moved left to make room for the emergency vehicle to pass. More than half of the 80 respondents had also mounted a pavement, moved right or sped up to get out of the way. Only 8 drivers had reversed to move out of the way. These results are considered further in the wider context within the Discussion. Respondents were given the opportunity to expand on their answer of “other” using a free text box, but no one chose to validate their answer, so it was not possible to further analyse the 11 responses.

#### 7.6.ii Question 11

*“What type of road are you usually on when dealing with this type of vehicle?”*

<b>Type of road</b>	<b>No. of respondents</b>	<b>% response</b>
Town/City	45	56.2
Rural	11	13.8
Dual Carriageway/Motorway	2	2.5
Mixed road type	22	27.5
	<b>80</b>	<b>100%</b>

**Table 7.5: Respondents frequency of road type when interacting with an EV**

More than half of the drivers (56.2%) had dealt with an emergency vehicle in a town / city environment.

In order to establish the types of manoeuvres drivers were performing, and specifically in which environment, a crosstabulation was applied to question 10 and 11 as seen in Table 7.6.

<i>If you were required to move your position have you ever needed to...?</i>	<i>What type of road are you usually on when dealing with this type of vehicle?</i>					<i>Total</i>
	<i>Town / City</i>	<i>Rural</i>	<i>Mixed</i>	<i>Dual</i>		
		<i>Road Type</i>	<i>Carriageway/Motorway</i>			
<b>Reverse</b>	5	1	2	0		<b>8</b>
<b>Mount a Pavement</b>	24	7	11	2		<b>44</b>
<b>Cross a Red Light</b>	9	2	5	0		<b>16</b>
<b>Move Lanes</b>	40	9	19	2		<b>70</b>
<b>Move Left</b>	42	11	21	1		<b>75</b>
<b>Move Right</b>	28	4	10	1		<b>43</b>
<b>Speed Up</b>	19	7	14	2		<b>42</b>
<b>Stop on a Pedestrian Crossing</b>	6	2	3	0		<b>11</b>
<b>Other</b>	5	4	2	0		<b>11</b>
					<b>320</b>	

Table 7.6: Crosstabulation between road type and driver manoeuvre

Of the 75 respondents who had previously been identified in question 10 as moving left this appears to be occurring predominantly in an urban environment as identified by 42 drivers. For a mixed road type, it was not possible to be more precise as to where the differing manoeuvres had occurred. In a rural setting 2 drivers stated that they have crossed a red traffic light and 2 stopped on a pedestrian crossing. These would be considered unusual features in a rural setting so it could be that they are semi-rural or possibly village type environments. For manoeuvres, previously considered driver violations in chapter 6, 44 reported having mounted a pavement, 16 had crossed a red light and 11 had stopped on a pedestrian crossing. A small number

of drivers reported an emergency vehicle encounter on a dual carriageway or motorway, which would result in a civilian driver action. It is not possible to draw any conclusions from the high speed responses, but the data was not excluded despite being limited, as it provided proportions of engagement in the wider context.

How long have you held a UK licence for?	What type of road are you usually on?					<i>Total</i>
	Town / City	Rural	Mixed Road	Dual Carriageway/ Motorway		
<b>Less than 2 years</b>	6	0	2	0	8	
<b>2 - 5 years</b>	7	1	2	1	11	
<b>6 – 10 years</b>	2	0	0	0	2	
<b>11 – 15 years</b>	4	1	1	0	6	
<b>16 – 20 years</b>	1	0	0	0	1	
<b>Over 20 years</b>	25	9	17	1	52	
<b>Total</b>	45	11	22	2	80	

Table 7.7: Crosstabulation between duration of Licence and type of road

The majority of experienced drivers (over 20 years) spent a significant proportion of their time on town or mixed road types. This group accounted for 52 out of the 80 respondents whilst the more inexperienced drivers had held a licence for less than 5 years.

### 7.6.iii Question 12

*“How do you initially identify an Emergency Vehicle is approaching?”*

Of the 80 respondents, 72 stated (Table 7.8) that they initially identified an emergency vehicle by the sirens; however, of those 80 respondents, the drivers saw the flashing blue lights and utilised their mirrors in equal proportions. For the sirens and flashing blue lights the similar proportions of response may be due to the emergency vehicle utilising the emergency warning systems in differing combinations. Whilst the

respondents identified the EV through flashing headlights less frequently than through other warning systems this method of identification still accounted for 31 out of 80 (38.75%) reported identifications.

<b>Identification method</b>	<b>Overall No. of responses</b>
Sound from the sirens	72
Flashing headlights	31
Flashing Blue Lights	65
Using your mirrors	64
Size of the vehicle	0
Colour of the vehicle	8
	<b>240</b>

**Table 7.8: Respondents self-report of EV identification by frequency**

A crosstabulation (Table 7.9) was applied to the identification method by a driver of an approaching EV against the road type where this may be encountered.

<i>What type of road are you usually on when dealing with this type of vehicle?</i>						
		Town / City	Rural	Mixed Road	Dual C'way Motorway	Total
<b>Sirens</b>		41	10	19	2	72
<b>Headlights</b>		16	6	8	1	31
<b>Blue Lights</b>		37	9	18	1	65
<b>Mirrors</b>		34	10	19	1	64
<b>Size</b>		0	0	0	0	0
<b>Colour of EV</b>		5	1	1	1	8
						<b>240</b>

**Table 7.9: Crosstabulation between drivers EV identification and road type**

72 drivers reported that they identified the emergency vehicle more often by the sirens and in Table 7.9, 41 of those encounters where sirens were a main identification factor, were in an urban environment. Only 2 drivers said that this was the method used on a dual carriageway / motorway.

Only 31 drivers reported that identifying headlights was the method they used to recognise an approaching emergency vehicle. Whilst half of those were in town/city areas, 6 highlighted that it would be when driving in a rural road (Table 7.9). It could be that in rural areas, there are fewer obstructions to mask the approaching vehicle such as other traffic or street furniture.

For the “Blue lights” category this identification method was used by 65 drivers, and of those, 37 were within an urban environment, with only 1 respondent stating that they had used this method on a dual carriageway. However, due to the small proportion of drivers who used this type of road no conclusion could be drawn.

The same proportion of drivers used their mirrors to identify an emergency vehicle which was approaching. Just one driver identified this method for a dual carriageway / motorway out of the two who used this type of road. No driver used the size of the vehicle as an identification method whilst 8 felt that the colour of the EV aided them.

How old is the vehicle you normally drive?	What type of road are you usually on when dealing with this type of vehicle?					<i>Total</i>
	Town / City		Rural	Mixed	Dual Carriageway / Motorway	
	Road Type					
<b>Less than 2 years</b>	10	0	4	1	<b>15</b>	
<b>2 – 5 years</b>	14	7	10	1	<b>32</b>	
<b>6 – 10 years</b>	13	3	8	0	<b>24</b>	
<b>11 – 15 years</b>	8	1	0	0	<b>9</b>	
<b>Total</b>	45	11	22	2	<b>80</b>	

Table 7.10: Crosstabulation between age of vehicle and road type

A crosstabulation of the road type where the interaction occurred compared to the vehicle age was applied (Table 7.10). This identified 24 vehicles in an urban area that were under 5 years old. For the dual carriageway both respondents were also in vehicles of this age. This information may provide an explanation as to why civilian drivers are not aware of an approaching emergency vehicle due to driving a modern vehicle which is recognised as having sound insulating properties. The results will be considered within the discussion chapter.

#### 7.6.iv Question 13

*How far away was the vehicle when you first noticed it? Please state approximate distance in metres*

Distance	No. of Respondents	% Response
Less than 15m	2	2.5
15 – 30m	6	7.5
31 – 50m	10	12.5
51 – 100m	22	27.5
100 – 200m	20	25
200 – 300m	7	8.7
300 – 400m	3	3.8
400 – 500m	6	7.5
Unsure	4	5
	<b>80</b>	<b>100%</b>

**Table 7.11: Respondents estimate of distance when first being aware of an EV by frequency**

Drivers were asked to estimate how far away the emergency vehicle was when they first noticed its presence. Distances varied from less than 15 metres through to 500 metres, but the highest category was between 51 – 100 metres identified by 22 drivers, and between 100 to 200m identified by 20 drivers. A comparison against previous published literature and an individual's ability to judge distance is considered in the discussion.

A crosstabulation comparing the initial identification method against distance and environment can be found in Appendix 20. Town and City identification varied with distances varying from 15 – 30 metres(16 drivers), 31 – 50 metres (23 drivers), 51 –

100 metres (38 drivers) and 200 – 300 metres (16 drivers). Rural road interactions were reported by the participants to be predominantly between 100 to 200 metres. All high speed road interactions were reported to be between 51 – 100 metres. For drivers on mixed roads this was also between 51 – 100 metres (19 drivers) and between 100 – 200 metres (15 drivers).

#### 7.6.v Question 14

*If you did not immediately see or hear the Emergency vehicle, why was that? Please mark all that apply.*

Whilst drivers have stated the distance's they believed the EV was away before identification, the question was also asked as to why this was not sooner.

Reason for delayed awareness	No. of responses
Monotonous roads	6
Familiar routes driven every day	4
Noise within the vehicle	36
Distracted	13
Did not see anything before it arrived	21
Other	19
	<b>99</b>

**Table 7.12: Drivers self-report reasons for not immediately observing an EV by frequency**

Drivers stated that the most common reason for failing to initially identify an EV that was approaching was due to the noise already within the vehicle (Table 7.12). When considering how vehicle age may impact on a driver's ability to notice an approaching emergency vehicle in good time, 21 vehicles were less than 5 years old and 11 vehicles up to 10 years old (Table 7.13). This may have contributed to further noise in the vehicle which could also have included passengers or music / radio. However, 21 drivers did not see or hear anything which suggests that, while noise was a possible factor, they may have been distracted in some other way whether physically or cognitively as observations were not frequent.

<i>If you did not immediately see or hear the emergency vehicle, why was that?</i>							
<i>Age of the vehicle</i>	<b>Monotonous Roads</b>	<b>Familiar Road</b>	<b>Noise in the vehicle</b>	<b>Distracted</b>	<b>Not see or hear anything</b>	<b>Other</b>	<b>Total</b>
<b>Less than 2 years</b>	1	1	9	2	1	1	15
<b>2 – 5 years</b>	3	1	12	6	13	7	32
<b>6 – 10 years</b>	2	0	11	3	5	8	24
<b>11 – 15 years</b>	0	2	4	2	2	3	9
<b>Total</b>	<b>6</b>	<b>4</b>	<b>36</b>	<b>13</b>	<b>21</b>	<b>19</b>	<b>80</b>

Table 7.13: Crosstabulation between age of vehicle and reason for lack of awareness

The noise impact or failing to see anything has been identified as occurring principally in a town / city environment. This will be considered further in the discussion.

<i>What type of road are you usually on when dealing with this type of vehicle?</i>					
	<b>Town / City</b>	<b>Rural</b>	<b>Mixed Road Type</b>	<b>Dual Carriageway / Motorway</b>	<b>Total</b>
<b>Monotonous Road</b>	1	0	5	0	6
<b>Familiar road</b>	3	0	1	0	4
<b>Noise in the vehicle</b>	25	3	8	0	36
<b>Distracted</b>	7	2	4	0	13
<b>Did not see or hear anything</b>	12	5	3	1	21
<b>Other</b>	8	5	6	0	19
<b>Total</b>	<b>56</b>	<b>15</b>	<b>27</b>	<b>1</b>	<b>99</b>

Table 7.14: Crosstabulation between reason for lack of awareness and road type.

Only 6 out of 80 drivers reported that their lack of early awareness of an emergency vehicle related to monotony and this was identified to occur principally on mixed type roads (Table 7.14).

#### 7.6.vi Question 15

*“How anxious do you feel when you realise that there is an Emergency Vehicle approaching?”*

Drivers were asked if they ever felt anxious when they realised that they were required to engage with a responding emergency vehicle. Shown in Table 7.15, 51 respondents (63.8%) did not or rarely reported feelings of anxiety with 13.8% of drivers reported feeling anxiety “most of the time” or “definitely”.

	Not at all	Rarely	Sometimes	Most of the Time	Definitely	Total
No. of respondents	34	17	18	7	4	80
% respondents	42.5	21.3	22.5	8.8	5	100%

Table 7.15: Drivers self-report of how anxious they feel when an EV is approaching by frequency

#### 7.6.vii Question 16

*“Do you consider that you always act in a controlled manner when dealing with an approaching Emergency Vehicle?”*

Despite the feelings of potential anxiety, drivers did not feel that this impeded their ability to take appropriate action in a controlled manner. From Table 7.16, 1 respondent felt they rarely acted in a controlled manner compared to 96.3% who reported that they had acted in a controlled manner “most of the time” or “definitely”.

	Not at all	Rarely	Sometimes	Most of the Time	Definitely	Total
No. of respondents	0	1	2	35	42	80
% respondents	0	1.3	2.5	43.8	52.5	100%

**Table 7.16:**

Drivers self-report of how controlled they believe they act when dealing with an EV by frequency

To investigate this in greater context a crosstabulation was applied to question 15 and 16.

Do you consider that you always act in a controlled manner when dealing with an EV?						
How anxious do you feel when you realise that there is an EV approaching?	Not at all	Rarely	Sometimes	Most of the Time	Definitely	Total
	Not at all	0	0	0	8	26
	Rarely	0	0	0	6	11
	Sometimes	0	0	1	14	3
	Most of the Time	0	1	0	5	1
	Definitely	0	0	1	2	1
Total		0	1	2	35	42
						80

**Table 7.17:**

Crosstabulation of a driver's reported anxiousness against how controlled the action was

26 drivers who reported that they “definitely” acted in a controlled manner also reported that they never felt anxious in that situation. However, there was a little more uncertainty with 14 drivers who thought they acted in a controlled manner “most of the time” did sometimes feel anxious. This would suggest that there is a link between a driver feeling more anxious and therefore believing that they act in a less than controlled manner. In order to establish any link a Spearman correlation was carried out.

		Q15	Q16
Q15	Spearman's correlation	1	-0.545**
	Sig ( 2 tailed)		0.000
	N	79	79
Q16	Spearman's correlation	-0.545**	1
	Sig (2 tailed)	0.000	
	N	79	80

\*\*. Correlation is significant at the 0.01 level (2-tailed).

**Table 7.18: Pearson correlation between question 15 and question 16.**

A test for correlation showed a strong negative correlation (Cohen, 1988) illustrating that the more the driver believes they acted in a controlled manner the lower the anxiety felt.

#### 7.6.viii Question 17

*Do you consider that your choice of a new road position is appropriate when waiting for an Emergency Vehicle to pass through?*

	Not at all	Rarely	Sometimes	Most of the Time	Definitely	Total
No. of respondents	1	4	6	38	31	80
% respondents	1.3	5	7.5	47.5	38.8	100%

**Table 7.19: Drivers self-report of how appropriate their chosen road position was by frequency**

Of the 80 respondents, only 5 drivers (6.3%) believed that their road position was “not at all” or “rarely” appropriate compared to 69 drivers (86.3%) who reported their amended position was appropriate “most of the time” or “definitely” when moving out of the way of the emergency Vehicle. A crosstabulation was applied to Q17 regarding appropriate road position against Q11 which considered the location where this occurred.

From the responses shown below in Table 7.20 only 3 drivers felt that their amended road position was “not at all” or “rarely” suitable in a town or city environment. One

driver believed that the road position was “rarely” appropriate within a rural area and one driver believed that the road position was “rarely” appropriate on a mixed road. 39 of the 80 drivers believed that their driving position was indeed appropriate “most of the time” or “definitely” over all road types considered.

		What type of road are you usually on when dealing with this type of vehicle?				
		Town / City	Rural	Mixed	Dual Carriageway / Motorway	Total
Do you consider that your choice of new road position is appropriate when waiting for an EV to pass through?	Not at all	1	0	0	0	1
	Rarely	2	1	1	0	4
	Sometimes	3	2	1	0	6
	Most of the Time	25	3	9	1	38
	Definitely	14	5	11	1	31
Total		45	11	22	2	80

Table 7.20: Crosstabulation of road type against how appropriate the new road position was

By comparing the driver road type against whether the choice of road was appropriate “most of the time” and “definitely”, 69 out of 80 drivers believed their choice of road position was appropriate over all road types. 6 drivers believed it was appropriate “some of the time”, whilst 5 felt it was “rarely” or not appropriate. No driver, from Table 7.20, thought that their action on a dual carriageway was inappropriate, whilst of the 69 drivers, 39 who deemed their action appropriate “most of the time” and “definitely” were in a town environment.

A crosstabulation was applied between whether a driver thought their road position was appropriate against the action they subsequently took. For those drivers who

considered they acted appropriately “most of the time” or “definitely” this applied to those who committed what were in fact determined to be driving violations (mounting a pavement, crossing a red light, and stopping on a pedestrian crossing). A small proportion of all responses (22 out of 320) did not believe their position was appropriate but these were a minority.

<i>Do you consider that your choice of new road position is appropriate when waiting for an EV to pass through?</i>						
	Not at all	Rarely	Sometimes	Most of the Time	Definitely	Total
<b>Reverse</b>	0	1	0	4	3	<b>8</b>
<b>Mount a Pavement</b>	0	3	5	23	13	<b>44</b>
<b>Cross a Red Light</b>	0	0	2	6	8	<b>16</b>
<b>Move Lanes</b>	1	4	5	35	25	<b>70</b>
<b>Move Left</b>	1	4	6	36	28	<b>75</b>
<b>Move Right</b>	0	2	4	25	12	<b>43</b>
<b>Speed Up</b>	1	3	3	22	13	<b>42</b>
<b>Stop on a Pedestrian Crossing</b>	1	0	0	7	3	<b>11</b>
<b>Other</b>	0	1	1	6	3	<b>11</b>
<b>Total</b>	<b>4</b>	<b>18</b>	<b>26</b>	<b>164</b>	<b>108</b>	<b>320</b>

**Table 7.21:**  
**Crosstabulation between chosen road position and whether the driver believed it appropriate**

## 7.7 Results summary

Utilising a questionnaire distributed through social media, 80 drivers responded relating to their experiences of emergency vehicle interactions.

Drivers were asked to report the type of manoeuvre undertaken when moving out of the way during an interaction. 75 drivers reported moving left, 70 moved lanes, 44 drivers mounted a pavement, 43 moved right and 42 would speed up to move out of the way. These results will be discussed in chapter 8 as to how they correspond to the real-world footage gathered from the Roads Policing vehicle. 56.2% of the interactions occurred in an urban environment then followed by 27.5% on mixed type roads, where drivers used a variety of roads during the course of their daily activities. A small number (11 drivers) reported that the interaction had occurred only within a rural setting and just 2 drivers were on a Dual Carriageway or Motorway reflecting traffic volumes.

72 civilian drivers reported that Emergency vehicles was identified most frequently through the use of sirens. This compared to 65 drivers who saw the flashing blue lights and 64 drivers used mirrors to aid in their identification which were most commonly at a self-reported distance of between 51 – 200 metres.

Drivers were asked to also consider why they may not have immediately been aware of an approaching emergency vehicle and 36 drivers reported that their own vehicle noise was the main factor, followed by 21 drivers who ‘did not see or hear anything’. 72 drivers were in a car, with 64 of those vehicles less than 10 years old.

96.3% of drivers believed that they had ‘most of the time’ or ‘definitely’ acted in a controlled manner and 86.3% felt their action was appropriate. 63.8% of drivers did not report feeling anxious in this situation and there was a strong negative correlation between reporting acting in a controlled manner and feelings of anxiousness.

## Chapter 8: Discussion

Civilian drivers and emergency drivers (on emergency response) have very different driving purposes and styles. Every day, there are numerous interactions that occur between these vehicles, and the vast majority happen without incident. However, some general under-reporting of traffic conflicts and near misses is evident and this is well-recognised within the literature (e.g. Heinrich, 1931, Jeffrey, 2009). Such under-reporting will almost certainly apply to conflicts/near-misses between civilian and emergency vehicles. Previous research also suggests that some collisions between emergency vehicles and civilian vehicles occur because civilian drivers do not know how to respond in such situations and are therefore usually considered the responsible party (Clarke et al, 2009). However, the research evidence that underpins this notion is somewhat isolated and unconvincing, and therefore there was a need to investigate this further. The over-arching gap in the knowledge identified at the outset of this thesis was therefore that there is a lack of a full understanding of the nature and behaviours of both types of drivers in a collision and how they could potentially be prevented through driver training, behaviour change or by other means including vehicle design and awareness campaigns.

In order to understand the relationship between (1) emergency vehicle drivers in marked and unmarked vehicles, and (2) civilian drivers, a mixed methods approach was taken, and four studies were conducted which involved addressing 8 research questions. Study 1 involved questionnaires based on self-reporting of the emergency drivers' opinions and experiences. Drivers from the three main UK emergency services were asked about their own driving and their opinion regarding that of civilian drivers. In addition, they were asked to report on feelings of frustration that were experienced under the two differing conditions of (1) emergency and (2) non-emergency driving. To corroborate the emergency drivers' views of collision causation, a second study (Study 2) reviewed collision data from a single UK Police Force to establish whether UK Police vehicle marking type influenced the liability of a collision. In this study, the vehicle telematics data for the emergency warning systems was first reviewed to establish whether the operation influenced liability. Whilst the telematics data was detailed and provided some interesting results, it did not however allow in-depth analysis on near misses and risky driving manoeuvres involving either a Police or

civilian driver. A third study (Study 3) was therefore designed in order to consider the interaction between emergency service and civilian vehicles involving a review of real-world footage. This was to establish whether UK Police drivers were accurate in their perception of how they or the civilian drove. Finally, it was important to establish the civilian drivers' own perspectives in terms of their actions and responses to an approaching emergency services vehicle which formed the basis of the final study (Study 4).

The rationale, results and policy implications of each study are described below.

*Study 1: Do Police, Fire and Ambulance Service emergency drivers report similar levels of frustration, and have the same perceptions of civilian driving, whilst they are on an emergency response.*

The overall aim of Study 1 was to establish the perceptions and frustrations of emergency service drivers during interactions with civilian vehicles to determine whether similar opinions of civilian drivers were evident amongst the emergency drivers across the 3 main emergency services. This was so that training approaches to emergency response driving could be formulated and/or other strategies could be adopted where indicated within the data analysis.

The research questions addressed within this study were as follows:

RQ1: Do Police, Fire and Ambulance service emergency drivers report similar levels of frustration, and have the same perceptions of civilian driving, whilst they are on an emergency response?

RQ2: Do the Police, Fire and Ambulance drivers have the same belief that drivers should discuss feelings after an emotional call?

RQ3: Do the Police, Fire and Ambulance Service emergency drivers each rate their own driving skills as more highly skilled than that of their colleagues in the corresponding emergency service?

Study 1 was designed since no previous study had directly compared the views of drivers from all three UK emergency services. The research literature indicated that for all drivers (regardless of profession) a common source of frustration involved slower moving vehicles (Trick et al. 2012; Kinnear et al. 2015) or general interaction with other road users displaying hesitation (Gulian et al. 1989). In connection to this, several studies have examined feelings of frustration experienced by emergency drivers towards civilian vehicles when the civilian drivers were attempting to give way. This study was conducted to examine the views of emergency service drivers to establish if they each reported similar feelings towards civilian drivers and to provide a comparison that has not previously been seen in the published literature.

In order to consider how an emergency driver may feel under the two states of driving (emergency and normal conditions) 370 participants from the three Services answered questions related to each state. The questions in this study were adapted from academically validated questionnaires and to ensure they were specifically relevant to the emergency driving sector, initial testing through a pilot study was conducted. Under emergency driving conditions, the Ambulance Service drivers reported feeling the most stressed and frustrated overall using a composite score, formed from selected elements in a questionnaire, while the Police drivers reported feeling the least stressed (mean ranks for the Police drivers 161.94, Fire Appliance drivers 184.23 and Ambulance service drivers 225.84,  $p<0.001$ ). Post hoc analysis revealed that stress level differences between drivers in the Police and Fire service was not statistically significant but the difference between the Ambulance service drivers was significantly different to the other two. The levels of reported stress and frustration differed between the services despite similar training syllabuses. Possible reasons for this are considered later in the discussion. As the drivers reported feelings of stress or frustration it was important to understand if they managed those feelings through effective coping strategies.

Coping mechanisms aid in the management of stressful or difficult situations so analysis to address RQ2 considered whether the Police, Fire or Ambulance services shared the same belief that drivers should discuss their feelings after an emergency drive to a stressful situation. The results suggested that the drivers for each of the Services report differing levels of willingness to engage in a process of discussion

around their feelings. The Ambulance service drivers reported the highest willingness to discuss feelings after an emergency, but this does not appear to be manifesting itself within a driving coping strategy, since Ambulance drivers reported feeling the most stressed and frustrated under emergency driving conditions. A willingness to discuss feelings, as shown most keenly by the Ambulance personnel was supported in the literature relating to 'black humour' (Alexander et al. 2009) whereby emergency service personnel made light of a shared stressful situation in a group or peer setting.

For driving under non-emergency, and therefore ordinary conditions, the Fire service drivers interestingly reported higher levels of frustration compared to Police and Ambulance drivers (Mean Ranks Police Service 152.15, Fire Service 214.79, Ambulance Service 206.39) and this difference was statistically significant ( $P<0.001$ ). Post hoc tests were significant for the Police/Ambulance and Police/Fire pairings. To gain a better understanding of why these results occurred, the questions forming the composite 'stress' score were analysed separately. When asked whether the drivers found the rush hour more stressful under normal driving conditions, the Fire service drivers were 46% less likely to report "not at all" compared to the Police service driver counterparts. 6.2% of Fire service drivers "definitely" felt more stressed in rush-hour driving but this was the case for only 1.3% of Police service drivers and 3.1% of Ambulance service drivers. When specifically considering the effect of a slow-moving vehicle, the Police and Fire service driver results were statistically different as a pairing using post hoc tests ( $U=5876.00$ ,  $Z=-5.399$ ,  $p<0.001$ ). 61.3% of Police Service drivers stated that they were "not at all" stressed by a slow-moving vehicle but for the Fire service drivers, this only applied to 29.2% of respondents. It is suggested that this difference in attitudes may be the result of a combination of factors: firstly, each emergency service trains their drivers in high-speed driving within the broad context of the High Speed Driver Competency and Training Framework (HSDT, 2008), with each service then able to interpret the course syllabus according to their individual needs. It is possible that the difference in feelings of reported stress are due to variation in interpretation of requirements within the training departments and the method of the subsequently delivered programmes (such as coaching compared to Instruction) according to that interpretation. In line with Salters-Pedneault et al. (2010) it was proposed that those within the emergency services chose the service which best suited their personality, so it is possible that the respondent's overall personality

influenced their response to questions around perceived stressful driving situations. Thirdly the literature reported that the vehicles used in the completion of their role handle differently such that an Ambulance is considered top heavy (Maguire et al. 2002), whilst a Fire Appliance may take longer to proceed through traffic due to its size (Missikpode et al. 2018). Interestingly the Fire respondents felt more frustration within normal conditions than under emergency conditions and this may reflect the difficulties of movement of the vehicle through traffic due to its increased size. Whilst driver training is principally focused on high speed driving these findings have shown that focus should also be applied to that of non-emergency driving situations, which for some Services provokes negative feelings and therefore further attention is required here.

Further analysis in Study 1 considered whether emergency drivers believed collisions were caused by other road users and were thereby apportioning blame elsewhere. The Ambulance service drivers, who had reported the highest number of single collisions in the participant background information, also believed that the other road users were more to blame than the other two services. However, none of the services reported overwhelmingly that the fault for collisions lay elsewhere with only 14.4% from the Ambulance service reporting that other road-users were to blame “most of the time”, compared to 12.4% of Fire service drivers and 10% of Police drivers. This suggests that whilst the Ambulance service were reporting higher levels of ‘blameworthiness’ towards the other road users, they are conceding that a significant proportion of collisions are not another party’s fault. Conversely, research by Biggers et al. (1996) found that, on investigating Ambulance collisions, 67% of collisions were the fault of the other road users which is at odds with the perception of respondents in this study.

It may be that the number of collisions experienced by the Ambulance service are higher overall, and the public are indeed to blame but unfortunately collision data was not available to confirm or discount this suggestion and the analysis had to utilise self-report data only. It is also feasible that the Ambulance drivers received different levels of training, as previously discussed, to mitigate such risks or that Ambulance drivers have certain perceptions of their own driving capability indoctrinated through their training which leads them to blame other drivers for collisions. The perception of self-

blame was higher with Police drivers and suggested that they may be more realistic about their collision liability and consider it as an inevitable part of their role, and this view is also supported by Dorn et al. (2003). The results have identified that the three emergency services held different views around how civilian drivers react.

The opinions and views of drivers from three emergency services, not previously compared in published literature, illustrated differences between each service. Questionnaire responses from the Emergency drivers showed that 88.1% of Police drivers believed they did not drive aggressively when on emergency response, compared to 77.9% of the Fire Service and 61.9% of the Ambulance Service drivers. Unique gathering of video footage from both marked and unmarked Police vehicles provided evidence of aggressive driving by the Police drivers (as assessed by expert Police driver trainers) which led to the civilian driver making the decision to move out of the way in a certain manner. This style of driving by the Police driver was further corroborated by the collision data analysis which showed a higher proportion of collisions with a poor gap judgement. The evidence of the Police driving in a more aggressive manner, from this thesis, is in line with De Grave et al. (2003).

Data analysis to investigate RQ3 examined whether each of the emergency services rated their own driving capability more highly than that of their colleagues in the corresponding emergency services, to determine potential differences across the services, despite similar training syllabuses. All emergency service participants were thus asked to consider three individual questions aimed at determining their own perceptions and how they compared to their peers. The Ambulance service and Fire service drivers rated their own driving skill as being higher than the Police service drivers which supports Waylen et al.'s study (2004). The results from the Ambulance and Fire service respondents are also in line with Lajunen et al. (1997) who reported that drivers who overestimate their driving skills were more emotional in their driving attitude, which in this study was found to be frustration. Previous research indicates that when a driver is experiencing individual stress leading to frustration, once a certain tolerance has been exceeded, anxiety levels can rise (Eysenck, 1989; Matthews, 2002) which subsequently affects driving performance (Yerkes Dodson, 1908). The data relating to civilian driving self-reports is discussed later in this chapter.

An interesting and unexpected finding, in relation to RQ3, was that Police drivers rated their own driving skill as lower than their emergency service driver counterparts which is at odds with other published findings (e.g. Waylen et al. 2004). The Police drivers' own self-perception of driving skills may be founded on their collision rate history, either individually or as a Force overall but it is also possible that the Police drivers are underestimating their skill and driving ability as they perceive their actions to be part of the role.

### *Policy implications of Study 1*

Study 1 has reported important results which have wider policy implications for emergency drivers. The findings have shown that, despite Health and Safety legislation and the provisions available through an Organisation, there remains an individual unwillingness to engage in a dialogue with colleagues (either formally through Occupational Health or Managers, and informally with peers). The literature discussed the negative driving behaviours surrounding stress or frustration if not appropriately managed, yet the results suggest that for some individuals' reservations appear to remain with perhaps 'heroism' qualities or fear of job loss preventing individuals accessing mental health services. For both the Police and Fire Service, it is recommended that they develop ways to engage their personnel, identifying any barriers preventing individuals from expressing their feelings thereby creating a more positive cultural environment.

The Ambulance Service participants showed that despite a strong willingness to discuss their feelings, it was not manifesting itself within their driving resulting in greater negativity towards other road users and potentially higher collision rates than their peers in corresponding services. It is suggested that the emotional responses reported during driving become a focus within any initial or refresher training programmes to aid in reducing the number of collisions or near misses. Additionally, the findings could be integrated into Police driver training programmes initiated every 3 – 5 years as also recommended by Lind (1998). The training received by Standard Response drivers should include greater emphasis on how to manage these feelings of frustration, whilst for the Advanced drivers they should be made more aware of how their driving style is perceived and the effect it can have on civilian driver reactions. It

should be noted that it is not necessarily the case that Standard Response drivers were less experienced (average time in service was 16.7 years) but they are not authorised to complete certain Police tactics (College of Policing<sup>22</sup>) and will have a differing Police role to that of their Advanced driver colleagues through the use of lower performance vehicles (College of Policing<sup>23</sup>). For the Fire Service, the results interestingly showed more frustration under non-emergency conditions and emphasis should be given to the vehicle size in traffic with an understanding that civilian drivers may not be aware of its limitations regarding vision or stopping capabilities.

### *Study 2: Analysis of collisions between Police and civilian vehicles*

Whilst the drivers in Study 1 were found to be experiencing frustrations and negative views towards civilian drivers, it also found that the emergency drivers only held the civilian drivers responsible/blameworthy for a relatively small proportion of crashes (10% of crashes for Police drivers, 12.4% for Fire service drivers and 14% for Ambulance service drivers). Therefore, Study 2 examined collisions involving both unmarked and marked police cars to determine whether the views of the emergency drivers (regarding collision culpability amongst drivers of emergency and civilian vehicles) could be substantiated through objective collision data, as opposed to subjective self-reported data.

Study 2 was conducted since previous published studies had suggested that there was a non-fault liability bias towards emergency drivers involved in collisions with civilian vehicles (af Wåhlberg, 2009; Dorn et al. 2019) although a significant limitation was that such studies had only considered collisions involving marked emergency vehicles. No previous studies have examined collisions between unmarked emergency vehicles on response and civilian vehicles and a gap in the literature was evident. The study was therefore conducted in order to look at liability aspects involving both marked and unmarked vehicles to determine whether the type of vehicle markings were factors in collision causation.

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<sup>22</sup> College of Policing – Authorisation to drive [Online] <https://www.app.college.police.uk/app-content/road-policing-2/police-driving/>

<sup>23</sup> College of Policing - Driver / Rider levels [Online] <https://www.app.college.police.uk/app-content/road-policing-2/police-driving/>

The research questions addressed within this study were as follows:

RQ4: Is liability of collision dependent on whether the Police emergency response vehicle is marked or unmarked?

RG5: Is the frequency of collisions between marked and unmarked Police emergency response vehicles and civilian vehicles dependent on time of day?

RQ6: Does the operation of the Police vehicle emergency warning systems affect the collision liability?

An initial collision data set, involving both marked and unmarked vehicles and spanning 4.5 years was gathered from a single Police Force. Subset analysis showed that unmarked Police vehicles numbered fewer in the Force fleet (compared to marked vehicles in operation), accounting for just 8.4% of all identified collisions with a civilian driver over the time frame of the study (Appendix 16). This compared to 20.3% for a marked vehicle. However, initial collision data when considering liability (assessed at the scene of the collision by a Police Investigator) for each of the marking variables, showed drivers of an unmarked Police vehicle were twice as likely to be struck by a third-party vehicle than be liable for striking a third-party vehicle. Conversely for a marked vehicle the Police driver was found to be 24% more liable than the third-party. Furthermore 30% of Police drivers who were in a marked vehicle were involved in multiple collisions but only 10% of Police drivers were in an unmarked vehicle which was involved in a multiple collision. This provided important initial evidence of the risks of driving a marked Police vehicle compared to an unmarked vehicle and suggested that vehicle markings are not significant in collision causation but only in relation to salience. A marked vehicle has greater conspicuity due to its high visibility livery yet was still involved in a greater proportion of collisions for the drivers, suggesting other factors may have an influence. The risks of drivers being involved in multiple collisions had previously been investigated through Custalow et al. (2004) involving Ambulance drivers but no research was identified which considered Police drivers.

This distinction between the two vehicle marking types (marked or unmarked) in terms of collision rates was further investigated in both study 2 and study 3 to determine if

the difference was due to vehicle conspicuity or another factor such as driver behaviour, or operational demand. Previous published studies have focused only on a liveried high visibility emergency vehicle so novel access to unmarked Police vehicles provided a valuable comparison allowing a conclusion of driver behaviour to be drawn. Cases of known collisions, as identified by the Police Force, were split to consider whether markings held any commonality in relation to liability which could help determine explanations for the results. Initial analysis of the collision data subset showed that a marked vehicle was much more likely to hit a third-party vehicle (88.2%) than an unmarked vehicle (11.8%). Whilst this in part reflects the lower volume of unmarked vehicles held within the Roads Policing function it should be noted that it was not possible to control for exposure (such as mileage, road type, or time driven). One of the reasons for this was that there was no additional information provided for any of the vehicles, including individual mileage records. However, it is acknowledged that unmarked vehicles may travel fewer miles (as noted by af Wåhlberg, 2009) due to the nature of their roles and therefore be less exposed to collision risk.

Thematic analyses of the collisions, where the Police vehicle hit a third party, looked for a common theme and a number were identified but the only common theme identified between unmarked (hit third party) and marked Police vehicles (hit third party) was “traffic lights”. As an example, Police vehicles were found to have travelled through red lights at the same time as other vehicles who were travelling through the same intersection with a green signal with neither being able to stop in time. This suggested that higher speeds or poor observations may have been a factor and not the influence of the vehicle markings as it affected both marking types (i.e. marked vs unmarked). More marked vehicles were identified as being involved in this type of incident, but this was most probably due to there being more marked vehicles in the Fleet. The self-report response from civilian drivers found that they were willing to pass through a red traffic signal to move out of the way of a responding vehicle, but this only applied to 11.3% of respondents in an urban setting, established through the questionnaire response. Data collected from a marked vehicle using the Dashcam identified several clips where the Police driver went through a red light. This resulted in some cases where the civilian driver was forced into making a rapid decision due to the progress of the marked vehicle and resulted in the civilian driver stopping in inappropriate locations such as within a Box junction. These results are corroborated

by Custalow et al. (2004) who reported that 74% of injury collisions in Ambulances occurred during lights and sirens mode with only 46% of non-injury collisions occurring in this mode. This suggests that higher speeds may have additionally been a factor since it is accepted that higher speeds increase both collision and injury risk (Kahn et al. 2001). Research from Clarke et al. (2009) also reported that emergency vehicle drivers were more likely to be involved in a collision where time pressure and excess speed were contributory factors but as they point out, this is often a role requirement.

Some of the themes identified in the thematic analysis related to the specific damage that had been caused to the vehicles themselves through probable positioning errors. These collisions could be linked to poor space management during the response drive in a marked car only which hit a third party, and this may provide useful additional evidence in determining the differences in driving risk for marked and unmarked vehicles. The marked vehicles were involved in more incidents where there was damage caused by limited space between the two parties, than any other vehicle marking or liability assignment. From the thematic analysis there was no evidence to suggest that the collisions were caused by poor vehicle conspicuity, as all were caused by the marked Police driver, and all were operating the emergency warning systems in various combinations. Clarke et al. (2009, p348) reported that emergency vehicles were over-involved in collisions where they "*failed to take account of a restricted view*" and failed to see a vehicle at a junction in time whilst travelling through a red light. The findings in this study, confirmed through the thematic analysis, support Clarke et al.'s study in relation to marked Police vehicles travelling through red lights who were found to be more likely liable and were therefore overrepresented.

Published studies reported that collisions involving marked emergency vehicles were more prevalent in the afternoon (Langham et al. 2002) with pursuit collisions more often occurring under the cover of darkness (Crundall et al. 2003). A literature gap was identified as published research had not considered an unmarked Police vehicle operating emergency warning system's by comparison. Therefore, to address RQ5, a review of whether collision frequency involving marked or unmarked Police vehicles was dependent on time of day was undertaken. Collisions were chunked into 4 equal time frames, (in line with Kahn et al. 2001) to establish any commonality or differences between marked and unmarked vehicles not previously considered. Analysis relating

to time of day in this study supported the earlier finding that vehicle conspicuity was not the main issue. No statistical difference was identified between time of day and the vehicle markings (marked or unmarked) for Police liable collisions. A higher proportion of cases involving marked Police vehicles, compared to unmarked vehicles, which were 'hit by a third-party' occurred between 00:00 and 05:59 which fits with operational activities. As suggested by Doleac and Sanders (2015), criminal activity is more common at this time and therefore these types of collisions are more prevalent. The results have shown that certain collision causation factors (in particular criminal intent) were more likely to occur under the cover of darkness but due to a deliberate act and was not dependent on the vehicle marking. These are new and important findings due to the previous lack of published studies around unmarked vehicles which could be used to inform policy. This is considered within the implications for the study later in this chapter.

Further consideration of unmarked Police vehicles found that 75 out of 97 collisions occurred whilst the vehicle was not on emergency response and would therefore not have been using active warning systems. The unmarked Police vehicle effectively became no different to that of vehicles driven by the general driving population, and it was possible that the Police vehicle would have been involved in a collision due to randomised probability.

Analysis of Police driver collision data in Study 2, revealed that of the vehicles which hit a third party, 12.1% were marked and 10.9% were unmarked. This difference was relatively small and initially suggested that physical vehicle markings alone did not influence the risk of collision involvement. Closer scrutiny of the data, and confirmed with thematic analysis, suggested that a marked vehicle was more likely to hit a third party due to positioning faults such as striking wing mirrors whilst making progress through traffic. However, for those where the Police vehicle was hit by a third party there was a greater likelihood that the vehicle would be unmarked covert type for operational reasons.

These are important findings as the results from this study have established, through unique comparison with unmarked Police vehicles, that additional factors to those

already reported are influencing collisions that occur between Police and civilian vehicles.

One possible explanation of the increased risk of marked vehicle collisions may be a behavioural change in the driver of the marked vehicle which is not evident in an unmarked vehicle. Police driver training for drivers of unmarked vehicles places an emphasis on their lack of visibility, which could mean that those drivers are more aware of the impact their visibility may have on other road users. The College of Policing (College of Policing <sup>24</sup>) states that "*Training and learning promotes specifics around driving safely, taking into consideration the potential response from the public*". Previous published studies have considered the fact the Police drivers may hold a sense of invulnerability, in a marked vehicle, due to their level of training and therefore believed that collisions were a necessary part of the role (Dorn et al. 2003), with Pinizzotto et al. (2002) reporting higher level of invincibility as previously discussed.

Previous published studies have evaluated the influence of lights and sirens (Custalow et al. 2004) at specified locations (such as intersections) or those more likely to involve an injury, with meta studies considering driver behaviour factors such as time pressure or emotion (Hsiao et al. 2018; Missikpode et al. 2018). These only reviewed marked emergency vehicles highlighting a further literature gap which had not considered liability between parties or those involving unmarked vehicles. To investigate if there was a behavioural link, data analysis to answer RQ6 considered if the operation of the emergency warning systems affected collision liability, uniquely across both marking types.

To examine this a subset of 33 collisions, extracted from the initial data set, involving an unmarked Police vehicle over a 4.5 year time frame were analysed. These vehicles were known to have been driving during an emergency, in which the Police vehicle was subsequently involved in a collision with a civilian driver.

For the unmarked vehicle, no collision occurred where the Police driver was liable whilst the emergency systems (headlights, blue lights or sirens) were in use. Three

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<sup>24</sup> College of Policing - Roads Policing [Online] <https://www.app.college.police.uk/app-content/road-policing-2/police-driving/>

out of four cases involved a deliberate act by the civilian to avoid arrest with the remaining incident attributed to lack of concentration by the driver of a Fire Appliance moving around a parked Police vehicle during an emergency call. The results were not statistically significant when compared to those for liability, but this is due to the very small data sample.

It is possible that the Police drivers were more conscious of the dangers and limitations that this type of vehicle marking can present with its lack of conspicuity. This assertion is in line with Loftus et al. (2011) who observed that Police drivers using covert vehicles wished to blend into the background and it is possible that drivers drove in line with recognition of their poor conspicuity to other drivers. When the unmarked vehicle was on response, and it could be established for certain that the emergency warning systems were not in use at the time, there was no statistical difference in collision liability for either party. This effect was seen when flashing headlights, blue lights or sirens were each considered independently. It is interesting to compare these findings to research by Custalow et al. (2004) who found that 47% of collisions occurred when the lights and sirens were operating, whilst only 9% occurred when they were switched off, although the vehicle was still travelling on response. This could suggest that collision risk is increased when the lights and sirens are operational, but it should be noted that in the case of Custalow et al. (2004), only liveried Ambulances were assessed without consideration for liability.

For a marked Police vehicle, known to be on response with the emergency warning systems operational, analysis identified an opposing effect to that found for an unmarked Police vehicle. The operation of the alternating flashing headlights increased liability on the part of the Police driver by 78%, blue light use by 69% and sirens use by 120%. As with the unmarked vehicle the effect on liability when any of the emergency systems were inactive, but the vehicle was on response, was similar for both parties with little difference evident. It should be highlighted that the results were also not statistically significant for unmarked vehicles. Due to the unique comparison across both marking types identifying the specific type of emergency warning system activated immediately prior to a collision taking place the results represent new findings.

If collision causation was due to the public not seeing or hearing a Police vehicle with operational warning systems, then it may be that the public could be considered liable for collisions through possible inattention. However, the results show that the Police drivers are more often blameworthy than the civilian drivers which reduces the probability of poor conspicuity but raises the question of why collision liability increases only under certain conditions. The thematic reasoning identified a marked vehicle only as likely to strike wing mirrors through poor gap judgement, as discussed earlier, so it is suggested that as salience has been eliminated as a causation factor, it could be a decrease in Police driver skill or behavioural changes influencing the outcome.

It is also argued that if the collisions in which the liable civilian driver vehicle struck a Police vehicle, were due to a lack of civilian driver skill, the proportion of those involving either a marked or unmarked Police vehicle would be similar. The civilian driver would have made a driving error regardless of the type of vehicle (i.e. marked/unmarked) they subsequently came in to contact with. It was shown that the operation of the emergency warning systems did not increase civilian driver liability for collisions involving a marked vehicle. For an unmarked vehicle, the operation of the warning systems did however increase civilian driver liability, and due to the effect being identified only when the warning systems were operational then one explanation for the difference is driver behaviour.

Therefore, vehicle visibility, whilst not significant in terms of physical conspicuity, appears to play a significant role in the behaviour of the Police driver. The data suggest that Police drivers rationalise that they are driving a high visibility Police vehicle with the emergency systems operating, and that other motorists must have seen or heard the vehicle approaching. On the other hand, with unmarked Police vehicles, the data in this study suggest that the Police driver appears far more aware of their lack of conspicuity together with the vehicle's different role within law enforcement compared to those of marked vehicles. This role variation was evidenced through Fleet reports and subsequent thematic analysis which identified 'suspect', 'police' and 'offending' for civilian liability collisions, which were not evident where the Police were considered liable.

### *Policy implications of Study 2 results*

Study 2 identified several important characteristics relating to marked and unmarked Police vehicles which have not been previously identified. Drivers of a marked vehicle have been shown to be at greater risk of being liable for a collision with a third party, which have important implications for future training, not only for the Police but all emergency services. Drivers should be made aware that a marked vehicle, operating emergency warning systems, does not necessarily make the vehicle immediately more visible to other road users in every scenario. Through understanding the influence that the use of emergency warning systems may have on their own driving behaviour, in this vehicle marking type drivers should be encouraged to show greater restraint through holding back until a sufficient gap in the traffic has become available to them.

For the Police commonly utilising unmarked vehicles, it is suggested that National Standards Driver training policy be reviewed and updated through the College of Policing. Emphasis should be placed on reinforcing awareness that the drivers are at increased risk of being targeted by another motorist with whom they are trying to engage with.

These recommendations would crucially aid in increasing road safety for both emergency drivers and civilian drivers alike, reducing costs for the Force from sickness, litigation, vehicle repairs or replacement.

### *Study 3: An observational approach to the interaction between Police and civilian drivers*

Having reviewed the collision data, it was recognised that study 2 had not been able to determine factors involved in near-miss events and unsafe acts which can potentially lead to collisions. Since these are acknowledged as being important events to explore in terms of development of remedial countermeasures, they were studied further within study 3. The study also investigated recorded near-miss events in more detail since the research indicates that (all) drivers can become frustrated by slower moving vehicles in the road and it was therefore suggested that such frustration could lead to collisions and conflicts.

The investigative method chosen was real-world observations (Carsten et al. 2013) as this provided an unobtrusive means of observing both the emergency and civilian driver behaviour during any interaction. Another benefit of this chosen method was that as Police are familiar with on-board recording, they would not be expected to modify their driving behaviour through the presence of a camera. Utilising real-world data from emergency vehicles was only once previously used in research to observe Fire Service driver behaviours in the cab (Burke et al. 2001).

The research question addressed in this study was as follows:

RQ7: Do civilian drivers react in an adverse driving manner when moving out of the way of a Police vehicle which is on response?

Experts examined the video footage to determine reaction events and distinct reaction patterns for civilian drivers according to road type. Within the footage, there were 10 cases of routine-based traffic violations seen within a built-up urban/city environment, involving a marked vehicle (only). They involved drivers mounting the pavement or crossing a red traffic light, and in one case then stopping in the box junction, to ease the Police vehicle's passage. All reaction events were judged by the Experts to have been conducted in an orderly manner by the civilian with no evidence of 'panic'. They appear to have been carried out in good faith, as also determined by the thematic analysis (in Study 2), but the reactions in fact constituted violations of UK road laws.

Specific clips were further reviewed by the Experts and there was an overall agreement that in some cases, the Police driver was forcing the public to make a decision, thereby creating the violation. Comments from the Experts consulted included "*Clearly pushing the public out of the way*", "*The Police Vehicle was approaching the junction and forced the drivers on to the pavements so gave them little choice*", "*The Police driver was too aggressive and should have held back and waited if there is no clear way through*", and "*The Police Vehicle once again forced the ordinary driver to make a decision*". Therefore, the analysis appears to suggest negative driving behaviours from the Police drivers, and this was a view supported by the Experts.

From the evidence gathered, the civilian drivers do not appear to be acting in a deliberately adverse manner. However, the emergency drivers, whilst believing the public were not acting out of malice and were being helpful, are also sometimes under the impression that the civilian was ‘panicking’, with Ambulance Service drivers most likely to believe this to the case. This could be linked to frustration in making progress on a response call and believing that collisions are an inevitable risk within the role of emergency driver.

In all cases where the civilian vehicle failed to notice the approaching Police vehicle, such events were on high speed roads (Dual Carriageway or Motorway), under well-lit artificial conditions or in daylight. Furthermore, the unmarked vehicle was noted to be dark in base colour and the marked Police vehicle was white with “Battenburg” style markings. It is possible to rule out any suggestion that civilian drivers failed to notice the responding emergency vehicle due to poor vehicle marking conspicuity since the unmarked Police vehicles experienced the same reaction from the civilian driver as the marked Police vehicle.

On high-speed roads, of the events considered to be a driver lapse as evidenced by the footage, 6 of the vehicles were passenger cars, 1 was a Heavy Goods Vehicle (HGV), 4 were Light Goods Vehicles (LGVs) and 1 was a Motorhome, illustrating a broad mix. A delay or poor reaction time of the driver was judged, within the analysis, to be over 2.5 seconds and was determined from the time the vehicle came into view on the vehicle camera until it indicated or commenced physical movement across to another lane. Of the cases where a delay was identified, the time ranged from 8 to 10 seconds for an impending unmarked Police car, and 7 to 12 seconds for a marked car. In one additional case, a Light Goods Vehicle (LGV) did not appear to move or show any awareness for 25 seconds despite the lane to the left being clear. The delay in reacting suggested that the driver may have been distracted in some way. The emergency vehicles were all utilising blue lights as was evident from the footage, but it was not possible to establish if they were also operating the flashing headlights or sirens. It is also possible that part of the delay was due to the vehicle type (i.e. LGV) making rear visibility more difficult. The LGV, by its very size creates blind spots for its driver thereby making close proximity vehicles more difficult to see. Additionally, an unmarked vehicle has discreet light fittings, (as discussed previously) so whilst the

vehicle presence may be even partially visible to the LGV driver it may not be identifiable as a Police vehicle. The Experts confirmed that the drivers of larger vehicles may have struggled to see the Police vehicles as once they were immediately behind, their opinion was that they were too close to be seen. One Expert observed “*in the civilian driver’s defence, it is a large vehicle and the Police Vehicle would have covered a distance of around 120m in 2 seconds. The Police vehicle reduces their speed to around 90mph but is quite close behind and is probably in the Motorhome driver’s blind spot. The Police driver should be sat off or nearside to try to gain the Motorhome driver’s attention*”. However, there was no discernible overall difference in the times between the two Police vehicle types suggesting that markings did not, in fact influence the reaction times in these instances.

These findings broadly support Sivak’s study (1996) which reported that correct identification of a Police vehicle with lights and sirens was more difficult to achieve whilst driving a larger commercial vehicle as both vision and hearing were required. In the clips reviewed, whilst the Police driver lane positioning may have been a factor towards the Police vehicle approach it cannot completely explain why the Police vehicles were not observed by the civilian driver on a straight, well-lit road with little external distraction. In order to be able to move in a timely manner the driver must first observe the presence of the rear vehicle. In this study, the roads were one directional and the opportunity is therefore solely reliant on the awareness and observational skills of the civilian driver. The ability to observe will be in part dependant on a driver’s concentration levels which may be influenced by the numerous distractions both internally and externally of the vehicle and previously considered in the Literature (Lee et al. 2008).

The overall study results have shown civilian drivers did not react in an adverse manner on a higher speed road, but that they may delay their reaction for several reasons. The Experts considered this to be in part due to the driving of the Police driver who was driving too close and who was possibly unaware that they were not visible to the civilian driver.

### *Policy implications of Study 3*

The results from study 3 demonstrated that manoeuvres undertaken by civilian drivers during the emergency vehicle interaction are strongly dependent on road type. An examination of incidents on urban roads revealed ill-judged but well-meant manoeuvres, as determined by Experts, whilst on high-speed roads there were only delayed movements from the civilian driver. It is therefore suggested that through tailored training programmes, Police drivers are encouraged to increase their understanding of the expected civilian driver actions but also recognise that they are often as a direct result of the method of approach of the Police driver themselves. This will benefit not only safety but potentially reduce the frustrations experienced by the emergency drivers previously reported in this thesis. The video analysis also suggested that Police drivers were not holding back sufficiently to provide drivers of large vehicles an opportunity to observe their approach on high speed roads. It is suggested that further training addresses this and emergency service drivers are made aware of the possibility that there are vision limitations for drivers of larger civilian vehicles which may be affecting how they respond. It is further recommended that Police drivers, more used to smaller high-performance vehicles, spend time in larger commercial vehicles (e.g. articulated trucks) to familiarise themselves with the difficulties of vision and larger blind spots and the dangers potentially concealed within them. This could be achieved whilst the vehicle is stationary so that training is not limited to those with lower vehicle licence categories, although it would be more effective if it could be conducted in a dynamic environment. For those in the Fire and Ambulance Service, already familiar with driving a larger vehicle, reinforcement of the difficulties associated with restricted vision during a training course is advisable as it may have been some time since the initial acquisition of the licence to drive such vehicles and refresher training could serve as a positive reminder.

### *Study 4: Self-report views of civilian driver behaviour around a responding Emergency vehicle*

Having considered the emergency driver opinions and looking at the evidence in the collision data and the video footage, it was important to also review civilian Driver

opinions and viewpoints to examine whether remedial countermeasures could also be indicated for this driver group. This was the basis for Study 4.

The study was conducted through a self-report questionnaire and the research question addressed in Study 4 was as follows:

RQ8: Do civilian drivers believe their driving action is appropriate and timely when they are required to move out of the way of a responding emergency vehicle?

The civilian drivers were asked through the questionnaire survey about how they thought they reacted in response to the presence of an emergency vehicle and of the 80 drivers who responded, 96.3% believed they acted in a controlled manner “most of the time” or “definitely”. This is in line with Saunders et al. (2003) who reported that 91% in their study also believed this. Respondents to the questionnaire stated that they became aware of an emergency vehicle from a distance of 15 – 30 metres in a town/built-up environment which could theoretically have involved an adverse driving reaction due to the close proximity (although as previously discussed there was no evidence of this behaviour from the video footage in Study 3). The Experts reviewing the video clips suggested that the manoeuvres were ill judged but there was no suggestion that the manoeuvres were unplanned or that drivers ‘panicked’ in any way. This suggests that civilian drivers appear to have a reasonably realistic and accurate perception of the actions they may undertake and are not ‘panicking’ as inferred in the literature.

### Rural Roads

In rural areas through the questionnaire survey, it was found that 10 civilian drivers initially identified an emergency vehicle by sirens, 9 by the Blue Lights and 10 by use of mirrors. The most common separation distance at the point of recognition was between 100 – 200 metres. 9 drivers had held a licence for more than 20 years, hence were considered experienced drivers. These findings concur with those of Underwood et al. (2003) who reported that experienced drivers checked the rear-view mirror more frequently having checked the road ahead and had longer and more varied fixations compared to novice drivers. Whilst all 11 drivers reported moving left, 4 drivers

reported they moved right and 7 mounted a pavement. These two latter manoeuvres would seem more unusual as lanes or pavements are not a common feature on a rural road and moving right could be deemed more hazardous for driving because of the possibility of meeting an on-coming car. However, the manoeuvre may also provide an indication of the size of rural road the driver was using.

### Mixed Roads

Having already discussed Motorway / Dual Carriageway, Urban and Rural road types the final road type examined was one that combined a variety of road types (Mixed) as part of their journey, accounting for 27.5% of civilian participants. For drivers reporting that they had driven on mixed roads most had held a licence for more than 20 years and those who stated they would speed up to move out of the way accounted for 33.3%. It was the 3<sup>rd</sup> most common reported manoeuvre for this road type, after moving left and moving lanes (in a town/city the 5<sup>th</sup> most common) but from the video footage, there was no evidence to suggest that drivers sped up on any road type. The three manoeuvres reported as least likely to be performed were crossing a red light, reversing and stopping on a pedestrian crossing but these were also infrequent in an urban setting. As discussed earlier, through analysis of video data, a small number of drivers in an urban setting were observed crossing a red light but again no cases were identified of drivers reversing or stopping on a pedestrian crossing. Civilian drivers reported identifying an approaching emergency vehicle in equal proportions by sirens, blue lights and mirrors, with all driving a vehicle that was less than 10 years old. As previously discussed, it is not possible to be certain that distances were accurately recalled by participants but on mixed road types, 19 drivers believed they first became aware of the approaching emergency vehicle when it was between 51 – 100 metres behind them, whilst 15 estimated the distance as being between 100 – 200 metres. These distances are consistent with those most frequently estimated by the civilian drivers across all other road types.

Across all road types, for the civilian respondents, distraction was identified as a factor in only 13.1% of the responses. Minimal distraction was identified in the responses from participants when driving on roads thought to be relatively “monotonous” thus having the lowest driver workload requirements, namely rural and high-speed roads.

This is broadly in line with Brookhuis et al. (1991) who reported that those who had an increased cognitive load, including that caused by distraction would conduct fewer mirror checks. It may be that drivers were genuinely not distracted but it could equally be the case that drivers do not recognise certain features of the driving task and the traffic environment as actual distractions. Furthermore, it is possible that drivers were not willing to admit to being distracted because of legal implications but responses were anonymous so this could not be explored in greater detail. The analysis then considered different road-types.

Overall, data analysis to address RQ8 found that the civilian drivers overwhelming believed they acted appropriately and as such the results found in favour of this question.

Study 4 has provided important new evidence, not previously identified in the literature into the perception of 'panic' surrounding civilian driver responses and has highlighted that there are large differences in the opinions of emergency drivers and civilian drivers. The view that civilian drivers were unpredictable (Dorn et al. 2003) and may panic when interacting with an emergency vehicle (Nakatani et al. 2009) could not be corroborated in this thesis. It is suggested that overall, the emergency drivers are not recognising the effect their driving has on the subsequent civilian response and this may also indicate some training interventions and/or a requirement for inducing behaviour change.

The results, from Study 4, showed that drivers reacted differently according to road type and this has important implications for traffic safety. From the responses received it became evident that civilian drivers were prepared to commit manoeuvres that they believed to be helpful although deemed ill-judged, to aid the passage of a Police vehicle, but do not panic as previously suggested.

#### *Policy implications of Study 4*

Due to the manoeuvres both witnessed and corroborated through self report by the civilian drivers it is recommended that civilian drivers are educated more comprehensively about what to do when they become aware of an approaching

emergency vehicle through public information channels. At present, there is no standard requirement and only limited and inadequate advice provided in the Highway Code (which was documented in the literature review). It is suggested that this be updated to provide more specific advice alongside increasing awareness of social media campaigns such as “Blue Light Aware” ([www.bluelightaware.co.uk](http://www.bluelightaware.co.uk)).

It was possible to surmise why civilian drivers delayed their actions on high speed roads, and considered a result of vehicle size, the proximity of the Police vehicle, sound proofing qualities and driver distraction (physical and cognitive). Whilst this final point could not be evidenced, due to externally gathered video footage, significant published research has highlighted its dangers. It is suggested that campaigns across numerous media platforms reinforce to drivers the dangers that engaging in these behaviours can bring, including failing to identify early an approaching emergency vehicle. Behavioural change techniques should be employed by trainers and investigators and have already been introduced into Police diversionary courses for driving offenders ([www.ndors.org.uk](http://www.ndors.org.uk)). Drivers can identify the risks to both themselves and other road users, removing the possibility of an inappropriate and potentially unsafe action.

## Chapter 9: Conclusion

### 9.1 Overall conclusion

This research set out to address how emergency warning systems influenced the behaviours of both an emergency driver and civilian driver. Whilst opinions had been advanced in published research, there was no evidence to substantiate claims made regarding poor civilian driving interactions between the two types of driver. A mixed methods study approach, over four studies, was designed to address this knowledge gap. This chapter presents the main conclusions, study limitations and recommendations for future work..

Following a pilot study, study 1 used self-report to consider the feelings and experiences of emergency drivers towards other road users, whilst they were driving in emergency and non-emergency states. Whilst in emergency response conditions the Ambulance service were more critical than their emergency driver peers towards civilian driver actions. Interestingly the Fire Service reported higher levels of stress under non-emergency conditions than when on response. No previous research was identified which provided a cross comparison across the main three UK emergency services thereby providing a unique insight as to the differing views and opinions between the Services.

For Study 2 privileged access was given to collision and telematics data over a significant time frame of 4.5 years which provided an opportunity to consider how the warning systems influenced collisions, uniquely across two Police vehicle marking types. Important results were established which showed that whilst emergency warning systems were switched off, during response, there was no effect on liability between the parties for either a marked or unmarked Police vehicle. For an unmarked vehicle, the operation of the warning systems saw liability fall onto a civilian driver but for operational reasons such as avoiding arrest. With a marked vehicle the emergency warning system operation showed liability move to the Police driver with siren use having the largest influence. These results illustrated that vehicle conspicuity was not a factor in these collisions, but driver behaviour changed due to the assumption of increased salience by the Police driver, not previously reported in published literature.

This was further validated through the use of thematic software which analysed the Fleet reports and showed that a marked vehicle was more likely to strike another vehicle or clip a wing mirror, whilst an unmarked vehicle was more likely to engage with an offender or suspect.

Study 3 built on these results further by gaining evidence of the interactions in a real world setting by on-board Police vehicle cameras. The errors identified were split distinctly across road type. For an urban environment poor civilian driving manoeuvres were observed as mounting a pavement, crossing a red light, hesitation and obstructing a junction. The manoeuvres were regarded as ill-advised in the case of urban roads, and for a high speed road it was evident that drivers delayed their reaction in an unacceptable time period. It was clear that Police drivers created many of the civilian driver errors through their own driving style, which was independently considered aggressive, pressured and pushy in nature.

The final study found that civilian drivers had an accurate recall on how they had manoeuvred during previous interactions, with their responses corroborating evidence identified from the real-world footage. Civilian drivers felt their action was appropriate and controlled and this was confirmed with the footage review by the expert driver trainers. Overall the evidence has shown that Police drivers experienced a change of behaviour in a marked vehicle operating the emergency warning systems, not present in an unmarked vehicle or when the systems were off, whilst civilian drivers did not panic or act in an unpredictable manner, but were in many cases responding to the action of the emergency driver.

## **9.2 Research Limitations**

This research has uncovered some insightful findings, discussions and conclusions within the field of Emergency Response driving and driver behaviours. However, several limitations have been encountered which are considered further below:

1. Study 1 utilised questionnaire responses from drivers for the three UK Emergency Services as part of their role. It was not possible to control how the questionnaire was completed regarding influence from other colleagues or discussions that may

have occurred. For the Police, completion was through an internal email system by the Researcher, whilst the Fire Service and Ambulance Services distributed from a central point of contact within the Organisation. This removed some researcher control regarding who then completed the questions and how much exposure they had themselves to response driving. For example, some respondents may have been authorised to drive but in reality, drove infrequently. All questionnaires were included in the subsequent analysis and it was not possible to establish the day to day exposure drivers may have had to civilian driver interactions.

2. The early study design proposed to compare data from all three Emergency Services throughout each separate study. Difficulties were experienced in gaining Ambulance Service collision data due to confidentiality and Data Protection concerns. The Ambulance Service additionally utilised the services of an external company to provide and manage the collection of on-board video recording (both driver and forward facing) but neither the Company or Ambulance Service could agree on who owned that data and as such permission could not be achieved. In the case of the Fire Service, one Service agreed in principle that windscreen mounted cameras could be fitted to a Fire Appliance to record response runs but this was overturned through concerns from their Union. It was decided to continue with the research from one Police Force only, where unlimited access to sensitive data had been granted to all areas required. Access to this type of data has been reported as difficult to obtain (James et al. 1991; Glendon et al. 2001; Dorn et al. 2003) and being able to gain permission to use such rich material allowed this study to explore aspects in greater depth than previously.
3. Differences in the opinions and feelings across the three Services have been discussed in detail but deeper analysis could have been achieved through access to the detailed syllabus of the driver training programmes. However, this was declined by the Ambulance Service who referred to the Driver Training and Advisory Group book for reference. It is possible that these individual courses may have in some way influenced the responses, but this could not be established and is recognised as a limitation which could not be overcome.

4. The collision data gathered from the Police related to both marked and unmarked type vehicles. However, sub analysis resulted in only a small number of unmarked Police vehicles being included. Telematics was only installed at the start of the time frame resulting in emergency warning system data being unavailable before that point, and as such further retrospective data for unmarked vehicles was not feasible. A Freedom of Information request determined that marked vehicles made up a significant proportion of the Forces' response resource at 80.5%, when compared to unmarked vehicles at 19.5% which reflected the small subset. The data analysis resulted in 33 unmarked Police vehicle collisions, with 18 of those identified as having working, or operational emergency warning systems. This meant that only limited statistical testing could be conducted.
5. Through the drivers unique 'collar number' collision data was traceable back to individual Officers, and whilst drivers are tracked on IR3+ the Force did not collect records related to each driver's work related mileage. It was established during the analysis that the IR3+ tracking relied on the drivers to log their details on each journey and it was known that this did not always occur, resulting in data gaps. This has resulted in an assumption that all drivers had equal exposure to risks within the driving context as it could not be controlled for. Furthermore, collision liability was assigned by a Senior Officer at the time of the collision event and has not been altered, thereby taken at face value. The issues around exposure were considered by Dorn et al. (2019) who suggested that if behavioural culpability was being evaluated then mileage or hours driven should be collected but this was not available. It is recognised that this is a limitation when considering multiple collisions for both marked and unmarked vehicles, but it could not be overcome in this study.
6. Study 3 focused on data collected from Roads Policing vehicles either through ANPR or Dashcam fitted on the windscreen. Due to data protection surrounding Police operations, the researcher was not able to capture data by being physically present in the vehicle. Subsequently a large quantity of additional data was collected which was diverse in terms of locations, times and road types. This led to a substantial amount of data being viewed that was not relevant to the study but conversely it has illustrated that a large proportion of Police driving itself is not on

emergency response. Furthermore to protect an Officers identity only forward facing footage was unencrypted at the initial data collection stage so it was not possible to establish the Police driver was ever in any way distracted, or engaged in multiple tasks such as operating the warning systems, and use of the Police communication radio. Real world observation precluded civilian driver activity within the confines of their vehicle not being captured so it has only been possible to surmise why reactions were delayed on high speed roads.

7. Civilian drivers were recruited through a snowball sampling methodology which resulted in 80 drivers subsequently responding to a questionnaire. The purpose of this method was to reduce the possibility of any researcher bias towards a particular group of drivers such as those in a certain occupation. The disadvantage of this method is that often connections link within similar social circles, including through their job role creating unintentional natural groups. Of those who responded half were in the Education sector, either as Teachers, Lecturers, Researchers and Students and it is not known whether this had any bearing on the responses, as they may have been geographically separated.
8. For those Police drivers identified through their Force ID number as being involved in a collision, an understanding of the factors surrounding the event may had been advantageous in identifying any behavioural factors. However, in some cases there would have been a significant time delay between being approached by the researcher and the original collision occurring, resulting in potentially inaccurate recall. The collision data gathered only gave brief event details and the full collision file may have provided additional insight, but it was not possible to access the records due to building works at HQ and all data was inaccessible – many still being held as paper records and now archived.

### **9.3 Recommendations for Future Work**

#### *Study 1*

1. Whilst each Service works under the National Guidelines for High Speed Training (HSdT, 2008) the delivery of such training and proportion of time spent on each

element is determined by the individual Police Force, Ambulance Trust or Fire Service. The responses in Study 1 differed across the three emergency services and it is possible training influenced those responses in some way. It is recommended that researchers observe an Emergency Response course within each of the Police, Fire and Ambulance driver training departments. This will allow researchers to map the volume of behavioural based elements delivered at each, in proportion to the whole course. It is hoped that a greater understanding of the influence training has in response to personality type will be achieved.

2. The Fire Service reported that they felt more stress when driving under non-emergency conditions than when on response. It was not possible to be conclusive as to why this was the case, but it is suggested that civilians are not providing the same space opportunities, as would be given under response conditions. They may not be aware of the visual difficulties and more limited handling capabilities a vehicle of this size can bring thus creating a frustration to the Fire appliance driver. It is proposed that further investigation would be beneficial to the Fire Service to investigate these reasons in greater detail so that they may change their training programmes and possibly engage with occupational health to meet their statutory duty under Health and Safety legislation.

### *Study 2*

1. The thesis has gathered data from a single Police Force, which provided access to Police driver databases, collision data, ANPR and dashcam footage. An analysis of Police collisions determined a significant result which showed that the use of emergency warning systems increased the likelihood of a Police driver being involved in a blameworthy collision, when on response. As this body of research used a single Police Force, it is proposed that additional studies consider data from other Police Forces to establish if the results were unique to South Wales Police or representative of the UK Forces as a whole.

Additionally, this body of research focussed on Police collisions only, due to data access issues, particularly with the Ambulance Service. Further research should be carried out, replicating this study through the Fire and Ambulance Service, to

establish if the increase in liability apportionment can be found, when the Emergency Warning Systems are operational.

2. A small data sample for unmarked Police vehicles was reviewed due to the volume of data available and the low number of unmarked vehicles held on the Fleet. The unmarked vehicles provided an important comparison to marked vehicles and helped establish driver behaviour factors within the results. To build on this further it is recommended that this study be replicated with a larger Force and/or over a longer time frame to ensure more unmarked vehicles could be included.
3. Previous research has suggested that there is a possibility of investigation bias whilst considering collision liability, either consciously or subconsciously. Further research is proposed which considers to what extent this may occur, where Police investigate collisions amongst their emergency service peers. If this is found to be the case the researcher would have the opportunity to make suggestions as to how this could be reduced such as through additional training or the use of external parties, providing greater confidence of impartiality to those involved.

### *Study 3*

The results from this thesis have suggested that a Police driver may experience a behavioural change whilst driving on response in a marked Police vehicle. This change may increase feelings of stress or frustration which could be undetected, or not recognised, by the driver. It is proposed that a study, which considers physiological measures, is carried out with Emergency Response drivers which would be designed to determine if changes can be detected when the EWS are operational.

### *Study 4*

1. Traditionally Fire Appliances in the UK have been LGV type with a base red colour. In Study 4 the respondents did not use size as a method for identifying an approaching emergency vehicle and only a small number of respondents using the vehicle colour in conjunction with other methods.



**Figure 9.1:**  
**WMFS 4 x 4 Fire Appliance**

West Midlands Fire Service have introduced vehicles into the Fleet which include silver 4 x4 type vehicles with red and yellow “Battenburg” markings. It is therefore recommended that research be carried out which investigates if the civilian reaction to a 4 x 4 type Fire appliance differs compared to the traditional appliance.

2. The civilian driver questionnaire asked at what distance the driver became aware of an emergency vehicle. It was apparent that their responses may have been inaccurate due to poor recall or being unable to accurately judge distance as previously considered by Caelli et al (1980). It is proposed that a new study should investigate this further to establish the degree at which individuals can determine distance when moving such as whilst driving.
3. Civilian drivers self-reported that they did not feel anxious when moving out of the responding emergency vehicles path. Additional analysis was not possible in this study due to the anonymity of responses and it is suggested that further studies utilising research methods such as skin conductance could further validate the civilian response.
4. Of the civilian respondents only 2 reported an emergency vehicle interaction on a Dual Carriageway or Motorway. This resulted in limited analysis and it is possible that the low number reflects the fact that, whilst an emergency vehicle may pass, the civilian driver has not taken any avoidance action. Further research would benefit from increasing the civilian driver sample size and therefore potentially the number of high speed road interactions. This is so that a more effective comparison

could be made, considering the results gained from the real world footage which led to observed delayed civilian reactions on this road type.

5. The real world footage collected evidence of activity or manoeuvres that were external to either the Police or civilian vehicle. Whilst this provided valuable evidence of the interactions it did not provide insight into why the interactions may have caused a delay or any type of adverse reaction. It would be beneficial if further research placed cameras inside both vehicles to 1.) establish if the Police driver was multi-tasking using on-board communication systems or distracted in some other way and 2.) gain further evidence of why a civilian driver may not immediately be aware of an impending emergency vehicle. One issue discussed in the literature regarding awareness was modern vehicle soundproofing from external sources such as the road or environment, alongside improved in-vehicle entertainment systems. Previous research was conducted several years ago (Solomon et al. 2002; Balastegui et al. 2013), and it is acknowledged that modern vehicles have improved since that time. It is strongly suggested that these studies be replicated to establish the distances where certain noise levels may be masked from the driver and to have a greater understanding of the impact it may have on overall driver awareness.

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## Appendix

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**Ethics Approvals (Human Participants) Sub-Committee**



**Ethical Clearance Checklist**

Has the Investigator read the 'Guidance for completion of Ethical Clearance Checklist' before starting this form?	Yes
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**Project Details**

1. Project Title: Does Emergency response increase driver stress and negatively affect driver behaviour? An evaluation from Blue Light and non-blue light users.

**Applicant(s) Details**

2. Name of Applicant 1: Sandra Macdonald-Ames	10. Name of Applicant 2: Professor Andrew Morris
3. Status: PGR student	11. Status: Staff
4. School/Department: Design School	12. School/Department: Design School
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7b. Telephone number: 07776 352847	15b. Telephone number: <a href="#">Click here to enter text.</a>
8. Supervisor: No	16. Supervisor: Yes
9. Responsible Investigator: No	17. Responsible Investigator: Yes

**Participants**

**Positions of Authority**

18. Are researchers in a position of direct authority with regard to participants (e.g. academic staff using student participants, sports coaches using his/her athletes in training)?	No
--	----

**Vulnerable groups**

19. Will participants be knowingly recruited from one or more of the following vulnerable groups?	
Children under 18 years of age	No
Persons incapable of making an informed decision for themselves	No
Pregnant women	No
Prisoners/Detained persons	No
Other vulnerable group Please specify: <a href="#">Click here to enter text</a>	No
<b>If you have selected No to all of Question 19, please go to Question 23.</b>	
20. Will participants be chaperoned by more than one investigator at all times?	Choose an item
21. Will at least one investigator of the same sex as the participant(s) be present throughout the investigation?	Choose an item
22. Will participants be visited at home?	Choose an item

**Researcher Safety**

23. Will the researcher be alone with participants at any time?	No
<b>If Yes, please answer the following questions:</b>	
23a. Will the researcher inform anyone else of when they will be alone with participants?	Choose an item
23b. Has the researcher read the 'guidelines for lone working' and will abide by the recommendations within?	Choose an item

**Methodology and Procedures**

24. Please indicate whether the proposed study:

Involves taking bodily samples (please refer to published guidelines)	No
Involves using samples previously collected with consent for further research	No
Involves procedures which are likely to cause physical, psychological, social or emotional distress to participants	No
Is designed to be challenging physically or psychologically in any way (includes any study involving physical exercise)	No
Exposes participants to risks or distress greater than those encountered in their normal lifestyle	No
Involves collection of body secretions by invasive methods	No

Prescribes intake of compounds additional to daily diet or other dietary manipulation/supplementation	No
Involves pharmaceutical drugs	No
Involves use of radiation	No
Involves use of hazardous materials	No
Assists/alters the process of conception in any way	No
Involves methods of contraception	No
Involves genetic engineering	No

Involves testing new equipment	No
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**Observation/Recording**

25a. Does the study involve observation and/or recording of participants?	No
If Yes:	
25b. Will those being observed and/or recorded be informed that the observation and/or recording will take place?	Choose an item

**Consent and Deception**

26. Will participants give informed consent freely?	Yes
---	-----

**Informed consent**

27. Will participants be fully informed of the objectives of the study and all details disclosed (preferably at the start of the study but, where this would interfere with the study, at the end)?	Yes
28. Will participants be fully informed of the use of the data collected (including, where applicable, any intellectual property arising from the research)?	Yes

29. For children under the age of 18 or participants who are incapable of making an informed decision for themselves:	
a. Will consent be obtained (either in writing or by some other means)?	N/A
b. Will consent be obtained from parents or other suitable person?	N/A
c. Will they be informed that they have the right to withdraw regardless of parental/guardian consent?	N/A
d. For studies conducted in schools, will approval be gained in advance from the Head-teacher and/or the Director of Education of the appropriate Local Education Authority?	N/A
e. For detained persons, members of the armed forces, employees, students and other persons judged to be under duress, will care be	N/A

taken over gaining freely informed consent?	
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**Deception**

30. Does the study involve deception of participants (i.e. withholding of information or the misleading of participants) which could potentially harm or exploit participants?	No
<b>If Yes:</b>	
31. Is deception an unavoidable part of the study?	Choose an item
32. Will participants be de-briefed and the true object of the research revealed at the earliest stage upon completion of the study?	Choose an item
33. Has consideration been given on the way that participants will react to the withholding of information or deliberate deception?	Choose an item

**Withdrawal**

34. Will participants be informed of their right to withdraw from the investigation at any time and to require their own data to be destroyed?	Yes
--	-----

**Storage of Data and Confidentiality**

35. Will all information on participants be treated as confidential and not identifiable unless agreed otherwise in advance, and subject to the requirements of law?	Yes
36. Will storage of data comply with the Data Protection Act 1998?	Yes
37. Will any video/audio recording of participants be kept in a secure place and not released for any use by third parties?	Yes
38. Will video/audio recordings be destroyed within ten years of the completion of the investigation?	Yes
39. Will full details regarding the storage and disposal of any human tissue samples be communicated to the participants?	N/A
40. Will research involve the sharing of data or confidential information beyond the initial consent given?	No
41. Will the research involve administrative or secure data that requires permission from the appropriate authorities before use?	No

**Incentives**

42. Will incentives be offered to the investigator to conduct the study?	No
43. Will incentives be offered to potential participants as an incentive?	No

inducement to participate in the study?	
---	--

**Work Outside of the United Kingdom**

44. Is your research being conducted outside of the United Kingdom?	No
<b>If Yes:</b>	
45. Has a risk assessment been carried out to ensure the safety of the researcher whilst working outside of the United Kingdom?	Choose an item
46. Have you considered the appropriateness of your research in the country you are travelling to?	Choose an item
47. Is there an increased risk to yourself or the participants in your research study?	Choose an item
48. Have you obtained any necessary ethical permission needed in the country you are travelling to?	Choose an item

**Information and Declarations****Checklist Application Only**

If you have completed the checklist to the best of your knowledge, and not selected any answers marked with an \* or †, your investigation is deemed to conform with the ethical checkpoints. Please sign the declaration and lodge the completed checklist with your Head of Department/School or his/her nominee.

**Checklist with Additional Information to the Secretary:**

If you have completed the checklist and have only selected answers which require additional information to be submitted with the checklist (indicated by a †), please ensure that all the information is provided in detail below and send this signed checklist to the Secretary of the Sub-Committee.

**Checklist with Generic Protocols Included:**

If you have completed the checklist and you have selected one or more answers in which you wish to use a Generic Protocol (indicated by #), please include the Generic Protocol reference number in the space below, along with a brief summary of how it will be used. Please ensure you are on the list of approved Investigators for the Generic Protocol before including it on the checklist. The completed checklist should be lodged with your Head of Department/School or his/her nominee.

**Full Application needed:**

If on completion of the checklist you have selected one or more answers which require the submission of a full proposal (indicated by a \*), please download the relevant form from the Sub-Committee's web page. A signed copy of this Checklist should accompany the full

[submission to the Sub-Committee.](#)

**Space for Information on Generic Proposals and/or Additional Information as requested:**

[Click here to enter text.](#)

**For completion by Supervisor**

Please tick the appropriate boxes. The study should not begin until all boxes are ticked.

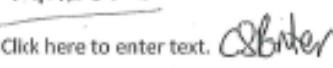
- The student has read the University's Code of Practice on investigations involving human participants
- The topic merits further research
- The student has the skills to carry out the research or are being trained in the required skills by the Supervisor
- The participant information sheet or leaflet is appropriate
- The procedures for recruitment and obtaining informed consent are appropriate

Comments from supervisor:

[Click here to enter text.](#)

Signature of Applicant: S Macdonald Ames

Signature of Supervisor (if applicable): Click here to enter text. 

Signature of Head of School/Department or his/her nominee: Click here to enter text. 

Date: Click here to enter text.

NOT PROTECTIVELY MARKED

## RESPONSE DRIVING – THE LAW AND YOU



Basic Driver pending training? Restricted to all speed limits all of the time.

Response Driver following training/re-assessment within previous 5yrs?

**30 40 50** = 10 to 15 mph over.  = 15-20 mph over.

NB. This is a RESTRICTION and not a TARGET TO REACH

*Road Traffic Regulation Act 1984, Section 87 as amended by the Road Safety Act 2006  
(which now requires officers to undergo 5-yearly assessment to maintain this exemption)*



Basic Driver pending training? NO EXEMPTION AT ANY TIME

Advanced Drivers and CURRENT response trained drivers...  
Treat as a STOP / GIVE WAY. Always be able to STOP in the distance seen to be clear and without causing other motorists to change speed or direction to avoid a Collision.  
Remember: J-PLAN It!

*The Traffic Sign Regulations and General Directions 2002, Regulation 36(1)(b)*



Advanced Drivers and CURRENT response trained drivers...  
Have a statutory exemption to contravene keep left/right bollards, HOWEVER this Must be carried-out in accordance with your training.  
Remember: J-PLAN it!

*Section 15(2) Traffic Sign Regulations and General Directions 2002)*



Basic Driver pending training? NO EXEMPTION AT ANY TIME

Advanced Drivers and CURRENT response trained drivers...  
May go against the direction/restrictions of road signs but only in a manner in accordance with their training.  
Remember: J-PLAN it!



**THERE IS NO EXEMPTION UNDER LAW FOR EITHER**  
failing to accord precedence on a crossing or...  
failing to keep to the left of a double white line where the line nearest you is solid.

Drivers utilising sirens should be aware of and attempt to minimise noise pollution. Refer to the National Response Manual on Connect under Policies and Procedures, Driving of Police Vehicles.

NOT PROTECTIVELY MARKED

Driving Test Report												DL25A	0408 T										
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												Total	S	D	Total	S	D	Total	S	D			
<b>1a Eyesight</b>												13. Move off	safely	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	23 Positioning	normal driving	<input type="checkbox"/>	<input type="checkbox"/>			
<b>1b II/Code / Safety</b>												control	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	lane discipline	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<b>2 Controlled Stop</b>												14 Use of	signalling	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	24 Pedestrian	crossings	<input type="checkbox"/>	<input type="checkbox"/>			
												signals	near obs.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	25 Position / normal	stops	<input type="checkbox"/>	<input type="checkbox"/>			
<b>3 Reverse / Left</b>												change direction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	26 Awareness /	planning	<input type="checkbox"/>	<input type="checkbox"/>				
Reverse with												change speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	27 Ancillary controls	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
instructor												necessary	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	28 Spars 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
												correctly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	29 Spars 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
												timed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	30 Spars 3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				
<b>5 Reverse Park</b>												16 Clearance /	obstructions	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	31 Spars 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
<b>R C</b>												17 Response	to signs	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	32 Spars 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			
												signals	road markings	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	33 Wheelchair	Pass <input type="checkbox"/> Fail <input type="checkbox"/>	Total	Pass			
<b>6 Turn in road</b>												traffic lights	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Failures	None				
												traffic controllers	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Reason No.					
												other road users	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
<b>7 Vehicle checks</b>												18 Use of speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
												19 Following	distance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	ETA	<input type="checkbox"/> Y <input type="checkbox"/> P <input type="checkbox"/>	DS5	<input type="checkbox"/>			
<b>8 Forward park / Tax</b>												20 Progress	appropriate	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Survey	A <input type="checkbox"/> B <input type="checkbox"/> C <input type="checkbox"/> D <input type="checkbox"/> E <input type="checkbox"/> F <input type="checkbox"/> G <input type="checkbox"/> H <input type="checkbox"/>					
												under instruction	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
<b>9 Tax wheelchair</b>												21 Junctions	approach speed	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Eco Safe driving	<input type="checkbox"/> Control <input type="checkbox"/> Planning					
												observation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Debrief	<input type="checkbox"/> Activity Code <input type="checkbox"/>						
<b>10 Unsigned / excepted</b>												turning light	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
												turning left	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	I acknowledge receipt of	Pass Certificate Number:	License held					
<b>11 Precautions</b>												cutting corners	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			Yes <input type="checkbox"/>					
												oversteering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wheelchair Cont. No.:		CSA <input type="checkbox"/>					
<b>12 Control</b>												steering	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>			No <input type="checkbox"/>					
												balance MC	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
												PCV door handle	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>								
												There has been no change to my health or score since last issued.											
												<input checked="" type="checkbox"/>											

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Form Ref. DL25 - www.dvsa.gov.uk

## Initial Questionnaire for South Wales Police Study



Dear Participant

### **Introduction**

Thank you for taking the time to complete these questionnaires of which this is the first of two. Any answers you provide will form part of research being undertaken by Sandra Macdonald-Ames through Loughborough University as part of a PhD.

Participation is voluntary and only the Researcher will know who has taken part.

South Wales Police fully support this study taking place and are working closely with the Researcher. SWP will not however have access to any questionnaire responses.

### **Purpose**

The study is investigating Blue Light Drivers, their feelings around general driving and then their response to Emergency calls which involves interacting with other road users.

Further investigations will be carried out in due course which will try to establish civilian drivers perception of how they drive themselves, collisions with Emergency vehicles alongside gathering video evidence of how civilian drivers aid with the passage of blue light vehicles. The Ambulance and Fire service will also be contributing to provide a balanced and broader view

### **Completion**

Please read all questions and answers carefully and try to answer as accurately as possible. It should take no more than 10 minutes to complete.

Please print out to complete and then scan

and return to [Sandra Macdonald-Ames swp90163, Driver Training Unit](#)

Your assistance and time are greatly appreciated.

*For any additional information about this research or any general questions please contact Sandra Macdonald-Ames (swp90163 at Driver Training & Loughborough University PhD research student),*

*or email:*

*Alternatively, Professor Andrew Morris, Loughborough University*

**SECTION A: BACKGROUND**

**Please tick one box only unless otherwise indicated.**

1. Please state your age in years: \_\_\_\_\_ Male  Female

2. Please state your Police driving qualifications: Standard  Advanced

3. How long have you held a full UK driving licence for? \_\_\_\_\_ years

4. How long have you been a Police Driver / Rider? \_\_\_\_\_ years

5. Estimate roughly how many miles you have driven in the past year (combining business and pleasure):

Less than 5000 miles  5000-10,000 miles  10,000-15,000 miles

15,000-20,000 miles  Over 20,000 miles

6. Please state whether you drive frequently on:

(tick one or more boxes as appropriate)

Motorways  Other main roads  Urban roads  Country roads

7. During the last three years, how many minor road collisions have you been involved in regardless of blame?

(A minor collision is one in which no-one required medical treatment, AND costs of damage to vehicles and property were less than £500). This is both work and private.

Number of minor collisions \_\_\_\_\_ (if none, write 0)

8. During the last three years, how many major road collisions have you been involved in regardless of blame?

(A major collision is one in which EITHER someone required medical treatment, OR costs of damage to vehicles and property were greater than £500, or both). This is both work and private

Number of major collisions \_\_\_\_\_ (if none, write 0)

9 . During the last four years, have you ever received points on your licence? Yes  No

a. How Many? \_\_\_\_\_

b. What were they for? \_\_\_\_\_

## **SECTION B**

Please answer the following questions on the basis of your feelings about driving generally (**not Emergency Response driving**). Each question asks you to answer according to how strongly you agree or disagree with the answers. To answer, put a circle which expresses your answer most accurately.

Be sure to answer all the questions, even if some of them don't seem to apply to you very well: guess as best you can if need be.

Example: Are you a confident driver?

The more confident you are, the closer to the 'Definitely' alternative you should circle your answer. If you are quite a confident driver you might mark it like this:

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

1. I always make an effort to stay calm and relaxed with other road users

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

2. I feel confident in my ability to avoid a collision

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

3. Other drivers are generally to blame for any difficulties I have on the road

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

4. When driving on an unfamiliar road I can become more tense than usual

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

5. When I am in a hurry, other drivers usually get in my way

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

6. Driving brings out the worst in people

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

7. I find it difficult to control my temper when driving

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

8. I think I have enough experience to deal with risky situations on the road safely

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

9. At times, I feel like I really dislike other drivers who cause problems for me

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

10. I can lose my temper when another driver does something I don't like

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

11. I overtake vehicles whenever possible

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

12. I am usually patient when driving as others may not be as experienced

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

13. Drivers for the Fire Service are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

14. Driving gives me a sense of power

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

15. I think it is worth taking risks on the road

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

16. There are too many unskilled drivers on the roads

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

17. It annoys me to drive behind a slow moving vehicle

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

18. Drivers are aware of how to drive appropriately when Emergency vehicles come through

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

19. When irritated I drive more aggressively

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

20. Ambulance drivers are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

21. Most collisions are caused by other road users

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

22. I always try to stay detached or distanced from the situation

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

23. Drivers need to be educated in how to react to Emergency vehicles

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

24. I become more impatient in the rush hour

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

25. Road users are being helpful when moving out of the way of an Emergency Vehicle

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

26. Driving makes me feel aggressive

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

27. It is important to let other drivers know they were at fault

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

28. Drivers seem to panic when they see an Emergency Vehicle with Blue lights operating

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

1	2	3	4	5
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29. I am patient with other road users so they do not feel under pressure

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

30. Police drivers are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

31. I have never showed other drivers what I thought of them

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

32. Other drivers need more training in how to drive properly

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

33. I like to try to make other drivers more aware of me by driving close behind them

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

# Follow up Questionnaire for South Wales Police Study (Blue Light)

(Version 2PT.2014)



Dear Participant

## **Introduction**

Thank you for taking the time to complete these questionnaires of which this is the second and final one. Any answers you provide will form part of research being undertaken by Sandra Macdonald-Ames through Loughborough University as part of a PhD. Participation is voluntary and only the Researcher will know who has taken part.

South Wales Police fully support this study taking place and are working closely with the Researcher. SWP will however have no access to any questionnaire responses.

## **Purpose**

The study is investigating Blue Light Drivers, their feelings around general driving and then their response to Emergency calls which involves interacting with other road users.

Further investigations will be carried out in due course which will try to establish civilian drivers perception of how they drive themselves, collisions with Emergency vehicles alongside gathering video evidence of how civilian drivers aid with the passage of blue light vehicles. The Ambulance and Fire service will also be contributing to provide a balanced view

## **Completion**

Please read all questions and answers carefully and try to answer the questions as accurately as possible. It should take no more than 10 minutes to complete.

Please print out to complete and then scan

and return to Sandra Macdonald-Ames (swp90163 Driver Training Unit)

[Sandra.Macdonald-Ames@south-wales.pnn.Police.uk](mailto:Sandra.Macdonald-Ames@south-wales.pnn.Police.uk)

Your assistance and time are greatly appreciated.

**SECTION A: BACKGROUND**

**Please tick one box only unless otherwise indicated.**

1. Please state your age in years: \_\_\_\_\_

Male  Female

2. Please state your Police driving qualifications:

Standard  Advanced

3. How long have you held a full UK driving licence for? \_\_\_\_\_ years

4. How long have you been a Police Driver / Rider? \_\_\_\_\_ years

5. Estimate roughly how many miles you have driven in the past year (combining business and pleasure):

Less than 5000 miles  5000-10,000 miles  10,000-15,000 miles

15,000-20,000 miles  Over 20,000 miles

6. Please state whether you drive frequently on:

(tick one or more boxes as appropriate)

Motorways  Other main roads  Urban roads  Country roads

7. During the last three years, how many minor road collisions have you been involved in regardless of blame?

(A minor collision is one in which no-one required medical treatment, AND costs of damage to vehicles and property were less than £500). – both work and private

Number of minor collisions \_\_\_\_\_ (if none, write 0)

8. During the last three years, how many major road collisions have you been involved in regardless of blame?

(A major collision is one in which EITHER someone required medical treatment, OR costs of damage to vehicles and property were greater than £500, or both). – both work and private

Number of major collisions \_\_\_\_\_ (if none, write 0)

9. During the last four years, have you ever received points on your licence? Yes  No

a. How Many? \_\_\_\_\_

b. What were they for? \_\_\_\_\_

## **SECTION B**

Please answer the following questions on the basis of your feelings about driving **when you are responding to an Emergency using Blue Lights and Sirens**. Each question asks you to answer according to how strongly you agree or disagree with the answers. To answer, put a circle at the point which expresses your answer most accurately.

Be sure to answer all the questions, even if some of them don't seem to apply to you very well: guess as best you can if need be.

Example: Are you a confident driver?

The more confident you are, the closer to the 'Definitely' alternative you should circle your answer. If you are quite a confident driver you might mark it like this:

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

1. I always make an effort to stay calm and relaxed with other road users whilst responding

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

2. I feel confident in my ability to avoid a collision whilst responding

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

3. When responding to an emergency other drivers are generally to blame for any difficulties I have on the road

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

4. When driving on an unfamiliar road with Blue Lights I can become more tense than usual

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

5. When I am in a hurry on the way to an emergency other drivers usually get in my way

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

6. Driving brings out the worst in people

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

7. When responding I find it difficult to control my temper when driving

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

8. When on Blue Lights I think I have enough experience and training to deal with risky situations on the road safely

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

9. At times, I feel like I really dislike other drivers who cause problems for me when I am responding

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

10. When responding with Lights and Sirens I can lose my temper when another driver does something I don't like

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

11. On response I overtake vehicles whenever possible

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

12. I am usually patient with others when on Emergency response as others may not be as experienced

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

13. Drivers for the Fire Service are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

14. Whilst operating with blue lights and sirens driving gives me a sense of power

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

15. I think it is worth taking risks on the road when on response

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

16. There are too many unskilled drivers on the roads

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

17. It annoys me to drive behind a slow moving vehicle if I am getting to an Emergency

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

18. Drivers are aware of how to drive appropriately when Emergency vehicles come through

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

19. When irritated I drive more aggressively

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

20. Ambulance drivers are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

21. Most collisions which involve an Emergency Response vehicle operating on Blue Lights are caused by other road users

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

22. I always try to stay detached or distanced from the situation whilst I am responding

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

23. Drivers need to be educated in how to react to emergency vehicles

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

24. I become more impatient in the rush hour

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

25. Road users are being helpful when moving out of the way of an Emergency Vehicle

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

26. Driving makes me feel aggressive when I am responding to an urgent call

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

27. It is important to let other drivers know they were at fault if they impede my Emergency progress

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

28. Drivers seem to panic when they see an Emergency Vehicle with Blue lights operating

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

29. When on response I am patient with other road users so they do not feel under pressure

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

30. Police drivers are highly skilled

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

31. I have never showed other drivers what I thought of them when I am responding to an emergency

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

32. Other drivers need more training in how to drive properly around Emergency vehicles

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

33. I like to try to make other drivers more aware of me by driving close behind them

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

**Frequency Tables (n=15) Initial Police questionnaire**

Q.No	Mean	Not at all %	Rarely %	Sometimes %	Most of the time %	Definitely %
<b>1</b>	4.33	0	0	0	66.7	33.3
The majority of Police drivers (n=10) try to stay calm most of the time, whilst 5 “definitely” reported staying calm.						
<b>2</b>	4.27	0	0	0	73.3	26.7
11 of the 15 participants felt confident in their ability to avoid a collision most of the time and 5 were “definitely” confident in their ability to avoid a collision.						
<b>3</b>	3.07	0	20.0	53.3	26.7	0
3 Police drivers felt other drivers rarely felt others were to blame for any difficulties, 8 participants felt that other drivers were sometimes to blame for difficulties on the road. Only 4 felt that this was the case most of the time.						
<b>4</b>	2.60	6.7	33.3	53.3	6.7	0
1 Police driving participant never became tense on an unfamiliar road, 5 participants rarely became tense on an unfamiliar road, whilst 8 felt they sometimes became more tense and one reported they did most of the time.						
<b>5</b>	2.27	20	40	33.3	6.7	0
3 police driver participants felt that other drivers never held them up, 6 participants felt other drivers rarely held them up when in a hurry, whilst 5 felt this was sometimes the case. Only one felt other drivers “definitely” held them up.						
<b>6</b>	2.60	6.7	33.3	53.3	6.7	0
1 police driver never through driving bought out the worst in people, 5 participants felt that driving rarely bought out the worst, whilst 8 thought that it sometimes did. One driver responded that driving bought out the worst most of the time.						
<b>7</b>	1.07	93.3	6.7	0	0	0
14 of the 15 participants never found it difficult to control their temper whilst driving. One driver believed this was rarely the case.						

<b>8</b>	4.27	0	0	6.7	60	33.3
9 Police drivers believed they had enough experience to deal with risky situations on the road most of the time, and 5 “definitely” believed they had. Only 1 driver felt that this was the case sometimes.						
<b>9</b>	1.80	40	46.7	6.7	6.7	0
6 Police drivers never felt they disliked other drivers, whilst 7 felt they rarely disliked other drivers who caused them problems. 2 drivers reported that they disliked other drivers “most of the time” or “definitely”.						
<b>10</b>	1.47	60	33.3	6.7	0	0
9 participants never lost their temper when another driver did something they did not like, whilst 5 rarely lost their temper. Just one driver reported losing their temper sometimes. This corresponds with the consensus of responses of Q7 and Q9.						
<b>11</b>	2.47	20	26.7	40	13.3	0
For Police drivers the question of whether they overtake whenever possible was broader in the responses, 3 stating they never overtook, 4 rarely, 6 sometimes and 2 most of the time.						
<b>12</b>	4.20	0	0	13.3	53.3	33.3
8 participants felt they were patient with other drivers less experienced “most of the time”, and 5 “definitely” felt they were. Only 2 drivers felt that they were sometimes patient with other drivers. This is in line with the questions regarding controlling temper where drivers felt they did so.						
<b>13</b>	3.80	0	0	33.3	53.3	13.3
5 Police drivers felt that drivers for the Fire Service were sometimes highly skilled, 8 responded with most of the time and 2 believed that they were “definitely” highly skilled.						
<b>14</b>	1.40	66.7	26.7	6.7	0	0
10 participants never felt that driving gave them a sense of power and 4 felt it rarely did so. Just one driver reported that sometimes driving gave them a sense of power.						
<b>15</b>	1.20	86.7	6.7	6.7	0	0
13 out of 15 responded by stating that it was never worth taking risks on the road, 1 stated rarely and 1 sometimes felt it was worth the risk.						

<b>16</b>	2.80	13.3	6.7	66.7	13.3	0
In asking whether there were too many unskilled drivers on the road, 10 believed that sometimes there were, whilst 2 felt there were never unskilled drivers, 1 rarely and 2 felt there were unskilled drivers most of the time.						
<b>17</b>	2.20	13.3	53.3	33.3	0	0
2 Police drivers felt that it never annoyed them to drive behind a slow moving vehicle (non - emergency), 8 rarely felt annoyed and 5 sometimes felt that it annoyed them.						
<b>18</b>	2.47	13.3	40	33.3	13.3	0
6 police drivers felt that civilian drivers were rarely aware of how to drive appropriately when an EV comes through, 5 felt that they were sometimes aware. 2 reported that civilian drivers never drive appropriately whilst 2 felt that it was appropriate most of the time.						
<b>19</b>	1.53	60.0	26.7	13.3	0	0
On non-emergency driving 9 participants felt they never drove aggressively when irritated, 4 felt they rarely became aggressive and 2 only sometimes.						
<b>20</b>	3.80	0	0	33.3	53.3	13.3
5 Police Drivers believe that the Ambulance drivers are sometimes highly skilled, 8 believed it was the case most of the time and 2 reported that they were "definitely" highly skilled. This is the same proportion as answered when considering the Fire Service driving skill (Q13).						
<b>21</b>	2.73	6.7	26.7	53.3	13.3	0
Only one police driver reported that collisions are never caused by other road users, 4 believed that rarely were the higher proportion of collisions a third party fault, the majority (8 drivers) believed that sometimes other road users were to blame with only 2 believing that it was most of the time.						
<b>22</b>	3.00	6.7	33.3	13.3	46.7	0
Only one Police driver reported that they were never detached from a situation, 5 felt they were rarely detached, 2 reported they were sometimes detached whilst 7 believed they were detached most of the time. The officers who were reporting not being detached are potentially going to be more vulnerable to stress.						

<b>23</b>	4.13	0	6.7	20	26.7	46.7
One driver reported that drivers rarely need to be educated in how to react to an EV, whilst 3 felt that sometimes they need to be educated, 4 reported that needed to be most of the time whilst 7 drivers believed that drivers "definitely" need to be educated in how to react to an EV. Whilst the participants report that they believed greater education is required they noted in Q12 that they did feel patient with other road users, were generally not unskilled (Q16), but gave a mixed response in that civilian drivers drove appropriately when an EV comes through (Q18).						
<b>24</b>	2.07	40	26.7	26.7	0	6.7
During non-emergency driving 6 police drivers reported never feeling more impatient in the rush hour, 4 rarely felt impatient, 4 sometimes did when only 1 "definitely" felt more impatient.						
<b>25</b>	4.07	0	6.7	20	33.3	40
One Police participant thought that the public were rarely being helpful, 3 felt that they were just sometimes helpful, 5 believed they were helpful most of the time and 6 believed they were "definitely" so. There did not seem to be an overall agreement between participants.						
<b>26</b>	1.07	93.3	6.7	0	0	0
When asked if driving made the Police drivers feel aggressive there was an overall agreement that 14 of the 15 never felt aggressive, and one reported rarely did they feel that way.						
<b>27</b>	1.93	20	66.7	13.3	0	0
3 respondents never thought you should let other drivers know they were at fault, 10 felt that it was rarely appropriate whilst just 2 thought that sometimes you should let them know. This is under non-emergency driving conditions and it is possible the police drivers took the question as an aggressive reaction rather than in their role as Roads Policing Officers. However, it is not possible to clarify the interpretation.						
<b>28</b>	3.60	0	0	53.3	33.3	13.3
When asked if the Police drivers thought civilian drivers panic upon seeing an EV, 8 drivers responded with sometimes, 5 most of the time and 2 "definitely" felt they panic. This is part of the thesis research as the Officers perception will be compared to the evidence gathered from the ANPR to establish any adverse civilian reaction.						

<b>29</b>	3.80	6.7	13.3	0	53.3	26.7
This question produced some broad responses, as 1 police driver was never patient with other road users, 2 were rarely patient so the civilian did not feel under pressure, 8 were patient most of the time and 4 were "definitely" patient.						
<b>30</b>	3.67	0	6.7	40	33.3	20
Police drivers were asked how highly skilled they believed they were themselves. The responses were broader than when asked about the Fire or Ambulance drivers. 1 felt they were rarely skilled, 6 reported sometimes, 5 felt they were most of the time and 3 believed they were "definitely" skilled. This is generally lower than Q13 and Q20 where no one reported rarely when considering the other emergency services.						
<b>31</b>	1.67	53.3	33.3	6.7	6.7	0
8 Police drivers felt that they never showed other drivers what they thought, 5 rarely had done so. Only two drivers reported that they sometimes or most of the time showed other drivers how they felt.						
<b>32</b>	2.93	0	20.0	73.3	0	6.7
In a non-emergency context 3 Police drivers reported that rarely did other drivers need more training in how to drive properly, 11 reported that sometimes they needed more training, and only one felt that they "definitely" needed more training.						
<b>33</b>	1.07	93.3	6.7	0	0	0
14 Police drivers reported that they never tried to make drivers more aware of their presence by driving close. Only one driver reported that they did so rarely.						

**Pilot study: Frequency Tables (n=4) Follow on Police questionnaire**

Q.No	Mean	Not at all %	Rarely %	Sometimes %	Most of the time %	Definitely %
<b>1B</b>	4.50	0	0	0	50.0	50.0
During the response drive 2 officers reported that tried to stay calm most of the time and 2 "definitely" tried to stay calm						
<b>2B</b>	4.75	0	0	0	25.0	75.0
During the response drive 1 officer felt confident most of the time in their ability to avoid a collision, while the remaining 3 were "definitely" confident in their ability.						
<b>3B</b>	3.50	0	0	50.0	50.0	0
When responding to an emergency 2 drivers believed that other drivers were sometimes to blame for difficulties and 2 reported that the other road users were to blame most of the time.						
<b>4B</b>	1.75	50.0	25.0	25.0	0	0
When driving on response on an unfamiliar road 2 drivers never reported feeling tense, 1 driver reported that they rarely felt that way, and 1 sometimes felt tense in those circumstances.						
<b>5B</b>	2.75	0	25.0	75.0	0	0
When on response 3 Police drivers felt that sometimes civilian drivers got in their way whilst only 1 reported that they rarely did.						
<b>6B</b>	3.0	0	25.0	50.0	25.0	0
When considering whether driving brings out the worst in people the respondents were split. 1 Police driver felt that rarely did it bring out the worst, 2 reported that it did sometimes and 1 said that it did most of the time.						
<b>7B</b>	1.25	75.0	25.0	0	0	0
On response 3 of the 4 Police drivers said that they never found it difficult to control their temper. 1 respondent said that it was rarely difficult. It is difficult to compare to the non-						

emergency response for Q7 where 14 out of 15 never found it difficult and only 1 found it difficult on a rare basis. The difficulty arises due to the sample size variations.						
<b>8B</b>	5.25	0	0	0	50.0	50.0
The Police respondents reported that for 2 of them they had enough response experience to deal with risky situations most of the time and 2 "definitely" believed they had enough experience.						
<b>9B</b>	1.25	75.0	25.0	0	0	0
On response 3 respondents never felt they disliked other drivers who caused problems, and one rarely felt they disliked the other road user.						
<b>10B</b>	1.50	50.0	50.0	0	0	0
2 Police drivers reported that whilst operating on response they never lost their temper and 2 felt they rarely lost their temper.						
<b>11B</b>	3.75	0	25.0	0	50.0	25.0
As with the non-emergency equivalent question the answers were split as one Police driver rarely overtook, 2 overtook most of the time and one "definitely" overtook whenever possible.						
<b>12B</b>	4.5	0	0	0	50.0	50.0
When other drivers may be considered less experienced 2 Police drives felt they were patient most of the time and 2 "definitely" patient.						
<b>13B</b>	4.0	0	0	25.0	50.0	25.0
When asked if the Police drivers believed the Fire Service were highly skilled 1 believed they were sometimes so, 2 most of the time and 1 "definitely" thought it was the case. As would be expected this is similar to the proportions for the initial questionnaire as it is likely the responses to the first question were considered under emergency conditions although this cannot be verified.						
<b>14B</b>	1.0	100.0	0	0	0	0

All Police drivers who participated stated that they never felt a sense of power whilst on response.						
<b>15B</b>	1.50	75.0	0	25.0	0	0
When on response 3 thought it was never worth taking risks and one felt that it was only sometimes worth the risk.						
<b>16B</b>	2.75	25.0	25.0	25.0	0	25.0
This answer divided all participants with each of the four replying never, rarely, sometimes and "definitely" felt there were too many unskilled drivers on the road.						
<b>17B</b>	2.0	50.0	25.0	0	25.0	0
When asked about whether a slow moving vehicle was deemed annoying 2 Police drivers said they were never annoyed, 1 driver rarely felt annoyed and believed that it did annoy them most of the time.						
<b>18B</b>	3.0	0	25.0	50.0	25.0	0
This question also divided the participants. One Police driver felt that civilian drivers rarely drove appropriately, 2 felt that civilian drivers sometimes did so, and 1 respondent said that the civilian drivers drove appropriately most of the time.						
<b>19B</b>	1.50	75.0	0	25.0	0	0
3 Police drivers reported that whilst on response they never drove more aggressively if irritated whilst one reported that they sometimes drove more aggressively.						
<b>20B</b>	4.0	0	0	25.0	50.0	25.0
One Police driver felt that Ambulance drivers were sometimes highly skilled whilst on response, 2 said they were highly skilled most of the time and one said they were "definitely" highly skilled mirroring the non-emergency replies.						
<b>21B</b>	3.0	0	25.0	50.0	25.0	0
1 Police driver believed that collisions involving an EV and a civilian were rarely caused by civilian drivers, 2 thought they were sometimes caused by them and one thought civilian drivers responsible most of the time.						

<b>22B</b>	3.75	0	0	25.0	75.0	0
When asked to consider how detached from a situation the Police drivers felt when responding 2 replied that they were sometimes and 3 believed they were detached most of the time.						
<b>23B</b>	3.25	0	25.0	50.0	0	25.0
The Police Officers were divided on whether civilian drivers needed to be educated in how to react with one police driver stating they rarely needed educating, 2 said that they sometimes needed to be, and one stated "definitely".						
<b>24B</b>	1.50	75.0	0	25.0	0	0
3 Police drivers reported that they never became impatient in the rush hour , only 1 reported that they sometimes became impatient. When compared to the non-emergency question on the initial question the Officers answers were more spread out in that circumstance. How no conclusion can be drawn due to the limited sample size.						
<b>25B</b>	4.0	0	0	25.0	50.0	25.0
Overall the Police drivers felt that the civilian drivers were helpful in moving out of their way whilst they were responding, with one believing that they were sometimes helpful, 2 police drivers said most of the time and one reported that they were "definitely" being helpful.						
<b>26B</b>	1.25	75.0	25.0	0	0	0
As with the non-emergency condition Police drivers felt that they did not become aggressive under the emergency state. 3 drivers reported they never felt aggressive and 1 stated that they rarely became aggressive.						
<b>27B</b>	1.25	75.0	25.0	0	0	0
In an emergency driving state, the Police drivers appeared to be more tolerant with 3 drivers never showing that other drivers were at fault, and one reported that they rarely let other drivers know they were at fault.						
<b>28B</b>	2.75	0	25.0	75.0	0	0
In the emergency driving condition, the 4 respondents were not as certain civilian drivers panic when they see an EV, when compared to the non-emergency state. 1 driver thought						

they rarely panic and 3 felt they panic sometimes. In the non-emergency driver state the drivers felt civilian drivers did panic more often.						
<b>29B</b>	4.50	0	0	0	50.0	50.0
Police drivers reported that whilst on response they were patient with other road users, as 2 officers stated that they were patient most of the time and 2 were "definitely" patient.						
<b>30B</b>	3.75	0	0	25.0	75.0	0
Under emergency conditions the Police drivers were more positive regarding their skill level as 1 felt they were sometimes highly skilled , and 3 believed they were skilled drivers most of the time.						
<b>31B</b>	2.25	50.0	25.0	0	0	25.0
The Police drivers responded with a wide range of answers, which was the same in the non-emergency driving condition. 2 drivers never showed other drivers what they thought, one said they rarely expressed their feelings to other drivers whilst one said they "definitely" would show their driving feelings to another motorist.						
<b>32B</b>	3.0	0	50.0	25.0	0	25.0
As with the non-emergency driving state, the responses fell into similar categories but very different proportions with more drivers responding to the rarely condition whilst on an emergency drive. 2 Police drivers rarely felt that other drivers needed more training in how to react to an EV, 1 driver stated that they sometimes needed more training whilst one said they "definitely" needed more training.						
<b>33B</b>	1.50	50.0	50.0	0	0	0
The Police drivers reported that for 2 respondents they never tried to make other drivers aware of them by driving close and 2 rarely drove too close.						

Questionnaire for  
South Wales Police Service  
(Blue Light Study)

Dear Participant

### **Introduction**

Thank you for taking the time to complete this questionnaire. Any answers you provide will form part of research being undertaken by Sandra Macdonald-Ames through Loughborough University as part of a PhD. Participation is voluntary and only the Researcher will know who has taken part.

South Wales Police fully support this study taking place and are working closely with the Researcher. SWP will however have no access to any questionnaire responses.

### **Purpose**

The study is investigating Blue Light Drivers, their feelings around general driving and then their response to Emergency calls which involves interacting with other road users.

Further investigations will be carried out in due course which will try to establish civilian driver perception of how they drive themselves, collisions with Emergency vehicles alongside gathering video evidence of how civilian drivers aid with the passage of blue light vehicles. The Police and Fire service will also be contributing to provide a balanced view

### **Completion**

Please read all questions and answers carefully and try to answer the questions as accurately as possible. It should take no more than 10 minutes to complete.

Please complete and then return to

Your assistance and time are greatly appreciated.

*For any additional information about this research or any general questions please contact Sandra Macdonald-Ames (Loughborough University PhD research student), or email:*

*Alternatively, Professor Andrew Morris, Loughborough University email:*

**SECTION A: BACKGROUND**

**Please tick one box only unless otherwise indicated.**

1. Please state your age in years: \_\_\_\_\_ Male  Female

2. Please state your Police driving qualifications: Standard  Advanced

3. How long have you held a full UK driving licence for? \_\_\_\_\_ years

4. How long have you been a Police Driver / Rider? \_\_\_\_\_ years

5. Estimate roughly how many miles you have driven in the past year (combining business and pleasure):

Less than 5000 miles <input type="checkbox"/>	5000-10,000 miles <input type="checkbox"/>	10,000-15,000 miles <input type="checkbox"/>
15,000-20,000 miles <input type="checkbox"/>	Over 20,000 miles <input type="checkbox"/>	

6. During the last three years, how many minor road collisions have you been involved in regardless of blame?

(A minor collision is one in which no-one required medical treatment, AND costs of damage to vehicles and property were less than £500). – both work and private

Number of minor collisions \_\_\_\_\_ (if none, write 0)

7. During the last three years, how many major road collisions have you been involved in regardless of blame?

(A major collision is one in which EITHER someone required medical treatment, OR costs of damage to vehicles and property were greater than £500, or both). – both work and private

Number of major collisions \_\_\_\_\_ (if none, write 0)

8. During the last four years, have you ever received points on your licence?

<input type="checkbox"/> Yes	<input type="checkbox"/> No
------------------------------	-----------------------------

a. How Many? \_\_\_\_\_

b. What were they for? \_\_\_\_\_

## **SECTION B**

Please answer the following questions based on your feelings about driving. Each question asks you to answer according to how strongly you agree or disagree with the answers. To answer, put a circle at the point which expresses your answer most accurately.

Be sure to answer all the questions, even if some of them don't seem to apply to you very well: guess as best you can if need be.

Example: Are you a confident driver?

The more confident you are, the closer to the 'Definitely' alternative you should circle your answer. If you are quite a confident driver you might mark it like this:

Not at all	Rarely	Sometimes	Most of the time	Definitely
1	2	3	4	5

	Not at all	Rarely	Sometimes	Most of the time	Definitely
I always make an effort to stay calm and relaxed around other road users <b>whilst responding</b>	1	2	3	4	5
I feel confident in my ability to avoid a collision <b>whilst responding</b>	1	2	3	4	5
<b>When responding</b> to an emergency other drivers are generally to blame for any difficulties I have on the road	1	2	3	4	5
When driving on an unfamiliar road <b>with Blue Lights</b> I can become more tense than usual	1	2	3	4	5
When I am in a hurry on the way <b>to an Emergency</b> other drivers usually get in my way	1	2	3	4	5
Driving brings out the worst in people	1	2	3	4	5
<b>When on Blue Lights</b> I think I have enough experience and training to deal with risky situations on the road safely	1	2	3	4	5
At times, I feel I really dislike other drivers who cause problems for me when I am <b>responding</b>	1	2	3	4	5

<b>When responding</b> with lights and Sirens I can lose my temper when another driver does something I don't like	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>On response</b> I overtake vehicles whenever possible	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I am usually patient with others when <b>on Emergency response</b> as others may not be as experienced	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Drivers for the Fire Service are highly skilled	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Whilst operating with Blue Lights and Sirens driving gives me a sense of power	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I think it is worth taking risks when <b>on response</b> to get to the Emergency quicker	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Following a difficult or traumatic call I would discuss my feelings with colleagues afterwards	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
	Not at all	Rarely	Sometimes	Most of the time	Definitely
I become more stressed when driving behind a slow moving vehicle if I am on my way <b>to an Emergency</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Civilian drivers are aware of how to drive appropriately when Emergency Vehicles come through	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Whilst responding</b> , when irritated by another road user I drive more aggressively	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Ambulance drivers are highly skilled	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Most collisions which involve an Emergency response vehicle are caused by other road users	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
I always try to stay detached or distanced from the situation whilst I am <b>responding</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Drivers need to be educated in how to react to Emergency Vehicles	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Under ordinary driving conditions</b> I become more impatient in the rush hour	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Road Users are being helpful to me when moving out of the way of the Emergency Vehicle	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Driving makes me feel more aggressive when I am <b>responding</b> to an Emergency call	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Following a difficult or traumatic call Emergency Services drivers should discuss their feelings with colleagues					
Drivers seem to panic when they see an Emergency vehicle with Blue Lights operating	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
When <b>on response</b> I am patient with other road users so they do not feel under pressure	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Police drivers are highly skilled	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Other drivers need more training in how to drive appropriately around Emergency vehicles	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
Emergency driving is a stressful part of my job	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
There are too many unskilled drivers on the road	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Under ordinary driving conditions</b> when irritated by another road user I drive more aggressively	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>When responding</b> I become more impatient in the rush hour	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Under ordinary driving conditions</b> I become more stressed when driving behind a slow moving vehicle	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
It is important to let other drivers know they were at fault if they impede my Emergency progress	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
	Not at all	Rarely	Sometimes	Most of the time	Definitely

***Thank you for your time***

**Scale: Composite stress****Case Processing Summary**

Valid Cases	N	%
Total	370	100

**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha	No. of items
Based on		
Standardised		
Items		
.744	.766	9

**Item Statistics**

	Mean	Std. Deviation	N
Q3	3.42	.931	370
Q4	2.55	1.109	370
Q5	2.58	.871	370
Q8	1.88	.922	370
Q9	1.56	.716	370
Q16	1.95	.837	370
Q25	1.24	.535	370
Q31	2.56	1.218	370
Q34	1.46	.729	370

**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q3	15.79	18.534	.239	.100	.751
Q4	16.66	15.942	.468	.248	.714
Q5	16.63	17.833	.370	.183	.729
Q8	17.32	16.371	.548	.355	.698
Q9	17.64	17.650	.524	.358	.709
Q16	17.25	16.960	.530	.346	.704
Q25	17.97	18.926	.452	.350	.724
Q31	16.65	16.315	.357	.172	.741
Q34	17.75	17.887	.470	.363	.716

**Scale Statistics**

Mean	Variance	Std. Deviation	N of Items
19.21	21.314	4.617	9

**Scale: Composite ‘Ordinary’ conditions****Case Processing Summary**

Valid Cases	N	%
Total	370	100

**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha Based on Standardised Items	No. of items
.600	.600	3

**Item Statistics**

	Mean	Std. Deviation	N
Q6	2.74	.914	370
Q23	1.98	1.071	370
Q35	1.76	.863	370

**Inter-Item Correlation Matrix**

	Q6	Q23	Q35
Q6	1.000	.169	.175
Q23	.169	1.000	.656
Q35	.175	.656	1.000

**Summary Item Statistics**

	Mean	Minimum	Maximum	Range	Maximum/ Minimum	Variance	No. of Items
Item Means	2.160	1.765	2.735	.970	1.550	.259	3

**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item- Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q6	3.75	3.101	.189	.036	.781
Q23	4.50	1.855	.529	.433	.298
Q35	4.72	2.312	.567	.434	.287

**Scale Statistics**

Mean	Variance	Std. Deviation	N of Items
6.48	4.543	2.131	3

**Scale: Composite Perception of Civilian driving****Case Processing Summary**

Valid Cases	N	%
Total	370	100

**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha	N of Items
	Based on Standardized Items	
.683	.664	7

**Item Statistics**

	Mean	Std. Deviation	N
Q17Atrans	3.36	.930	370
Q20	2.87	.654	370
Q22	4.34	.962	370
Q24ATrans	1.97	.860	370
Q27	3.41	.848	370
Q30	3.86	1.058	370
Q32	3.18	1.129	370

**Inter-Item Correlation Matrix**

	Q17Atrans	Q20	Q22	Q24ATrans	Q27	Q30	Q32
Q17Atrans	1.000	.055	.309	.156	.434	.424	.395
Q20	.055	1.000	.149	-.036	.076	.198	.094
Q22	.309	.149	1.000	-.004	.286	.578	.188
Q24ATrans	.156	-.036	-.004	1.000	.009	.052	.187
Q27	.434	.076	.286	.009	1.000	.385	.320
Q30	.424	.198	.578	.052	.385	1.000	.367
Q32	.395	.094	.188	.187	.320	.367	1.000

**Summary Item Statistics**

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	3.285	1.970	4.343	2.373	2.204	.565	7

**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q17Atrans	19.64	10.547	.533	.322	.608
Q20	20.13	13.493	.148	.045	.698
Q22	18.65	10.921	.438	.347	.635
Q24ATrans	21.03	13.219	.108	.056	.716
Q27	19.59	11.359	.447	.258	.635
Q30	19.13	9.562	.603	.456	.579
Q32	19.82	10.127	.450	.241	.632

**Scale Statistics**

Mean	Variance	Std. Deviation	N of Items
23.00	14.631	3.825	7

**Scale: Composite Coping****Case Processing Summary**

Valid Cases	N	%
Total	370	100

**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha	N of Items
	Based on Standardized Items	
.526	.591	7

**Item Statistics**

	Mean	Std. Deviation	N
Q1	4.58	.542	370
Q11	4.21	.782	370
Q18trans	4.72	.581	370
Q21	3.42	1.174	370
Q28	4.15	.905	370
Q33Atrans	4.52	.755	370
Q36Atrans	4.28	.915	370

**Summary Item Statistics**

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Itens
Item Means	4.270	3.424	4.719	1.295	1.378	.182	

**Inter-Item Correlation Matrix**

	Q1	Q11	Q18trans	Q21	Q28	Q33Atrans	Q36Atrans
Q1	1.000	.269	.274	.075	.310	.115	.156
Q11	.269	1.000	.232	.177	.329	.170	.037
Q18trans	.274	.232	1.000	.020	.222	.442	.293
Q21	.075	.177	.020	1.000	.096	-.016	-.047
Q28	.310	.329	.222	.096	1.000	.143	.130
Q33Atrans	.115	.170	.442	-.016	.143	1.000	.161
Q36Atrans	.156	.037	.293	-.047	.130	.161	1.000

**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q1	25.32	7.480	.354	.168	.469
Q11	25.68	6.727	.366	.183	.444
Q18trans	25.17	7.141	.433	.299	.442
Q21	26.47	6.922	.085	.039	.598
Q28	25.74	6.384	.354	.178	.443
Q33Atrans	25.37	7.182	.265	.204	.485
Q36Atrans	25.61	7.128	.175	.102	.525

**Scale Statistics**

Mean	Variance	Std. Deviation	N of Items
29.89	8.823	2.970	7

**Scale: Composite Perception of own driving ability****Case Processing Summary**

Valid Cases	N	%
Total	370	100

**Reliability Statistics**

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.214	.241	5

**Item Statistics**

	Mean	Std. Deviation	N
Q2	4.52	.516	370
Q7	4.27	.750	370
Q10trans	2.56	1.154	370
Q13trans	4.44	.910	370
Q14trans	4.70	.607	370

**Inter-Item Correlation Matrix**

	Q2	Q7	Q10trans	Q13trans	Q14trans
Q2	1.000	.294	-.046	.052	-.046
Q7	.294	1.000	-.104	.013	-.026
Q10trans	-.046	-.104	1.000	.144	.117
Q13trans	.052	.013	.144	1.000	.199
Q14trans	-.046	-.026	.117	.199	1.000

**Summary Item Statistics**

	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of Items
Item Means	4.099	2.557	4.697	2.141	1.837	.767	5

**Item-Total Statistics**

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Q2	15.97	3.590	.099	.092	.186
Q7	16.22	3.447	.015	.095	.252
Q10trans	17.94	2.487	.064	.040	.248
Q13trans	16.05	2.634	.199	.059	.053
Q14trans	15.80	3.349	.149	.050	.144

**Scale Statistics**

Mean	Variance	Std. Deviation	N of Items
20.49	4.050	2.012	5

\* Red text highlights significant results where p<0.05

Question	N	Mean	Std. Deviation	$\chi^2$	Df	P value	Significant (p<0.05)	Mean Ranks (Police n=160)	Mean Ranks (Fire n=113)	Mean Ranks (Ambulance n=97)
1	370	4.58	0.542	11.657	2	0.003	Yes	196.01	196.94	158.33
2	370	4.52	0.516	19.334	2	0.000	Yes	208.92	174.57	159.60
3	370	3.42	0.931	0.664	2	0.717	No	181.08	191.06	186.32
4	370	2.55	1.109	13.137	2	0.001	Yes	166.19	188.41	213.96
5	370	2.58	0.871	2.649	2	0.266	No	175.81	192.16	193.72
6	370	2.74	0.914	1.539	2	0.463	No	178.27	191.55	190.38
7	370	4.27	0.750	12.909	2	0.002	Yes	182.93	209.23	162.09
8	370	1.88	0.922	40.948	2	0.000	Yes	155.32	183.38	237.76
9	370	1.56	0.716	17.435	2	0.000	Yes	176.26	169.18	219.76
10	370	3.44	1.154	20.830	2	0.000	Yes	157.84	201.45	212.55
11	370	4.21	0.782	0.375	2	0.829	No	187.84	186.51	180.46
12	370	3.72	0.978	10.108	2	0.006	Yes	174.35	210.49	174.78
13	370	1.56	0.910	28.735	2	0.000	Yes	156.95	206.52	208.11
14	370	1.30	0.607	29.095	2	0.000	Yes	166.99	218.29	177.84
15	370	3.31	1.235	33.033	2	0.000	Yes	159.81	178.57	235.95

Question	N	Mean	Std. Deviation	$\chi^2$	Df	P value	Significant (p<0.05)	Mean Ranks (Police n=160)	Mean Ranks (Fire n=113)	Mean Ranks (Ambulance n=97)
16	370	1.95	0.837	0.483	2	0.786	No	181.73	186.51	190.55
17	370	2.64	0.930	6.234	2	0.044	Yes	196.75	187.85	164.20
18	370	1.28	0.581	25.381	2	0.000	Yes	166.71	185.35	216.66
19	370	3.68	0.963	10.621	2	0.005	Yes	178.21	171.63	213.68
20	370	2.87	0.654	2.234	2	0.327	No	180.92	181.78	197.39
21	370	3.42	1.174	4.350	2	0.114	No	184.04	173.11	202.34
22	370	4.34	0.962	14.687	2	0.001	Yes	166.95	188.63	212.45
23	370	1.98	1.071	21.380	2	0.000	Yes	157.97	210.62	201.66
24	370	4.03	0.860	1.187	2	0.552	No	191.61	178.52	183.55
25	370	1.24	0.535	8.645	2	0.013	Yes	175.05	185.36	202.90
26	370	3.60	1.153	29.688	2	0.000	Yes	160.62	180.57	232.28
27	370	3.41	0.848	4.525	2	0.104	No	175.00	186.13	202.09
28	370	4.15	0.905	5.224	2	0.073	No	193.99	190.08	166.16
29	370	3.89	0.879	19.066	2	0.000	Yes	165.05	183.85	221.14
30	370	3.86	1.058	12.240	2	0.002	Yes	164.33	201.66	201.60
31	370	2.56	1.218	5.095	2	0.078	No	175.71	182.32	205.36
32	370	3.18	1.129	10.780	2	0.005	Yes	166.29	206.50	192.72

Question	N	Mean	Std. Deviation	$\chi^2$	Df	P value	Significant (p<0.05)	Mean Ranks (Police n=160)	Mean Ranks (Fire n=113)	Mean Ranks (Ambulance n=97)
33	370	1.48	0.788	34.672	2	0.000	Yes	154.23	211.49	206.81
34	370	1.46	0.729	5.964	2	0.051	Yes	180.22	176.69	204.47
35	370	1.76	0.863	33.461	2	0.000	Yes	152.00	216.50	204.65
36	370	1.72	0.915	15.644	2	0.000	Yes	208.10	164.12	173.12
Comp. Perception	370	3.29	0.546	18.423	2	0.000	Yes	159.07	198.48	213.97
Stress Ordinary	370	2.16	0.710	28.449	2	0.000	Yes	152.15	214.79	206.39
Stress Response	370	2.13	0.513	21.676	2	0.000	Yes	161.94	184.23	225.84

\*Red text highlights significant results where p<0.05

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q1	Police (n=160) Fire (n=113)	8937	-0.193	0.847	No	No	137.64 136.09		
	Police (n=160) Ambulance (n=97)	6181	-3.176	0.001	Yes	Yes		138.87 112.72	
	Fire (n=113) Ambulance (n=97)	4424	-2.781	0.005	Yes	Yes			114.85 94.61
Q2	Police (n=160) Fire (n=113)	7347.50	-3.080	0.002	Yes	Yes	147.58 122.02		
	Police (n=160) Ambulance (n=97)	5705.00	-4.120	0.000	Yes	Yes		141.84 107.81	
	Fire (n=113) Ambulance (n=97)	5023.50	-1.201	0.230	No	No			109.54 100.79
Q4	Police (n=160) Fire (n=113)	7958	-1.749	0.080	No	No	130.24 146.58		
	Police (n=160) Ambulance (n=97)	5752.50	-3.609	0.000	Yes	Yes		116.45 149.70	
	Fire (n=113) Ambulance (n=97)	4727.00	-1.792	0.073	No	No			98.83 113.27
Q7	Police (n=160) Fire (n=113)	7732	-2.294	0.022	Yes	No	128.83 148.58		
	Police (n=160) Ambulance (n=97)	6863	-1.745	0.081	No	No		134.61 119.75	
	Fire (n=113) Ambulance (n=97)	4106.50	-3.474	0.001	Yes	Yes			117.66 91.34

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q8	Police (n=160) Fire (n=113)	7599.50	-2.447	0.014	Yes	Yes	128.00 149.75		
	Police (n=160) Ambulance (n=97)	4371.50	-6.246	0.000	Yes	Yes		107.82 163.93	
	Fire (n=113) Ambulance (n=97)	3800.00	-4.056	0.000	Yes	Yes			90.63 122.82
Q9	Police (n=160) Fire (n=113)	8685	-0.642	0.521	No	No	139.22 133.86		
	Police (n=160) Ambulance (n=97)	5926	3.524	0.000	Yes	Yes		117.54 147.91	
	Fire (n=113) Ambulance (n=97)	3991.50	-3.761	0.000	Yes	Yes			92.32 120.85
Q10	Police (n=160) Fire (n=113)	6890	-3.460	0.001	Yes	Yes	123.56 156.03		
	Police (n=160) Ambulance (n=97)	5484	-4.070	0.000	Yes	Yes		114.77 152.46	
	Fire (n=113) Ambulance (n=97)	5132.50	-0.829	0.407	No	No			102.42 109.09
Q12	Police (n=160) Fire (n=113)	7193	-3.109	0.002	Yes	Yes	125.46 153.35		
	Police (n=160) Ambulance (n=97)	7696.50	-0.115	0.909	No	No		129.40 128.35	
	Fire (n=113) Ambulance (n=97)	4504	-2.433	0.015	Yes	Yes			114.14 95.43

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q13	Police (n=160) Fire (n=113)	6643	-4.674	0.000	Yes	Yes	122.02 158.21		
	Police (n=160) Ambulance (n=97)	5589	-4.719	0.000	Yes	Yes		115.43 151.38	
	Fire (n=113) Ambulance (n=97)	5458.50	-0.055	0.956	No	No			105.31 105.73
Q14	Police (n=160) Fire (n=113)	6537	-5.159	0.000	Yes	Yes	121.36 159.15		
	Police (n=160) Ambulance (n=97)	7301	-1.250	0.211	No	No		126.13 133.73	
	Fire (n=113) Ambulance (n=97)	4278	-3.374	0.001	Yes	Yes			116.14 93.10
Q15	Police (n=160) Fire (n=113)	8142	-1.440	0.150	No	No	131.39 144.95		
	Police (n=160) Ambulance (n=97)	4547	-5.725	0.000	Yes	Yes		108.92 162.12	
	Fire (n=113) Ambulance (n=97)	3799.50	-3.944	0.000	Yes	Yes			90.62 122.83
Q17	Police (n=160) Fire (n=113)	8607	-0.705	0.481	No	No	139.71 133.17		
	Police (n=160) Ambulance (n=97)	6393	-2.482	0.013	Yes	Yes		137.54 114.91	
	Fire (n=113) Ambulance (n=97)	4781.50	-1.676	0.094	No	No			111.69 98.29

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q18	Police (n=160) Fire (n=113)	8116	-2.252	0.024	Yes	No	131.23 145.18		
	Police (n=160) Ambulance (n=97)	5677.50	-5.011	0.000	Yes	Yes		115.98 150.47	
	Fire (n=113) Ambulance (n=97)	4540	-2.678	0.007	Yes	Yes			97.18 115.20
Q19	Police (n=160) Fire (n=113)	8747	-0.484	0.629	No	No	138.83 134.41		
	Police (n=160) Ambulance (n=97)	6300.50	-2.679	0.007	Yes	Yes		119.88 144.05	
	Fire (n=113) Ambulance (n=97)	4206.50	-3.132	0.002	Yes	Yes			94.23 118.63
Q22	Police (n=160) Fire (n=113)	7968	-1.868	0.062	No	No	130.30 146.49		
	Police (n=160) Ambulance (n=97)	5862.50	-3.769	0.000	Yes	Yes		117.15 148.55	
	Fire (n=113) Ambulance (n=97)	4762.50	-1.987	0.047	Yes	No			99.15 112.90
Q23	Police (n=160) Fire (n=113)	6449.50	-4.301	0.000	Yes	Yes	120.81 159.92		
	Police (n=160) Ambulance (n=97)	5945	-3.377	0.001	Yes	Yes		117.66 147.71	
	Fire (n=113) Ambulance (n=97)	5233	-0.588	0.556	No	No			107.69 102.95

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q25	Police (n=160) Fire (n=113)	8533.50	-1.235	0.217	No	No	133.83 141.48		
	Police (n=160) Ambulance (n=97)	6594	-2.932	0.003	Yes	Yes		121.71 141.02	
	Fire (n=113) Ambulance (n=97)	4958.50	-1.602	0.109	No	No			100.88 110.88
Q26	Police (n=160) Fire (n=113)	8065	-1.576	0.115	No	No	130.91 145.63		
	Police (n=160) Ambulance (n=97)	4754.50	-5.430	0.000	Yes	Yes		110.22 159.98	
	Fire (n=113) Ambulance (n=97)	3948	-3.656	0.000	Yes	Yes			91.94 121.30
Q29	Police (n=160) Fire (n=113)	8089.50	-1.604	0.109	No	No	131.06 145.41		
	Police (n=160) Ambulance (n=97)	5439	-4.279	0.000	Yes	Yes		114.49 152.93	
	Fire (n=113) Ambulance (n=97)	4344	-2.764	0.006	Yes	Yes			95.44 117.22
Q30	Police (n=160) Fire (n=113)	7211.50	-2.987	0.003	Yes	Yes	125.57 153.18		
	Police (n=160) Ambulance (n=97)	6200.50	-2.848	0.004	Yes	Yes		119.25 145.08	
	Fire (n=113) Ambulance (n=97)	5478	-0.006	0.995	No	No			105.48 105.53

Question	Pairing	Mann Whitney U	Z	P value	Significant (p<0.05)	Significant ( $\alpha_{altered} = 0.017$ )	Mean Ranks	Mean Ranks	Mean Ranks
Q32	Police (n=160) Fire (n=113)	7102.50	-3.143	0.002	Yes	Yes	124.89 154.15		
	Police (n=160) Ambulance (n=97)	6624.50	-2.055	0.040	Yes	No		121.90 140.71	
	Fire (n=113) Ambulance (n=97)	5045	-1.027	0.304	No	No			109.35 101.01
Q33	Police (n=160) Fire (n=113)	6282	-5.366	0.000	Yes	Yes	119.76 161.41		
	Police (n=160) Ambulance (n=97)	5514	-4.940	0.000	Yes	Yes		114.96 152.15	
	Fire (n=113) Ambulance (n=97)	5302	-0.450	0.653	No	No			107.08 103.66
Q35	Police (n=160) Fire (n=113)	5876	-5.399	0.000	Yes	Yes	117.23 165.00		
	Police (n=160) Ambulance (n=97)	5563.50	-4.209	0.000	Yes	Yes		115.27 151.64	
	Fire (n=113) Ambulance (n=97)	5141.50	-0.832	0.406	No	No			108.50 102.01
Q36	Police (n=160) Fire (n=113)	6882.50	-3.658	0.000	Yes	Yes	150.48 117.91		
	Police (n=160) Ambulance (n=97)	6301	-2.730	0.006	Yes	Yes		138.12 113.96	
	Fire (n=113) Ambulance (n=97)	5222	-0.677	0.498	No	No			103.21 108.16

<b>Comp Perception</b>	<b>Police (n=160)</b>	7077.50	-3.064	0.002	Yes	Yes	124.73
	<b>Fire (n=113)</b>						154.37
	<b>Police (n=160)</b>	5494.00	-3.934	0.000	Yes	Yes	114.84
	<b>Ambulance (n=97)</b>						152.36
	<b>Fire (n=113)</b>	4984.50	-1.134	0.257	No	No	101.11
	<b>Ambulance (n=97)</b>						110.61
<b>Ordinary Driving</b>	<b>Police (n=160)</b>	5940.00	-4.891	0.000	Yes	Yes	117.63
	<b>Fire (n=113)</b>						164.43
	<b>Police (n=160)</b>	5524.00	-3.922	0.000	Yes	Yes	115.02
	<b>Ambulance (n=97)</b>						152.05
	<b>Fire (n=113)</b>	5270.50	-0.485	0.628	No	No	107.36
	<b>Ambulance (n=97)</b>						103.34
<b>Stress on Response</b>	<b>Police (n=160)</b>	7960.00	-1.685	0.092	No	No	130.25
	<b>Fire (n=113)</b>						146.56
	<b>Police (n=160)</b>	5070.50	-4.667	0.000	Yes	Yes	112.19
	<b>Ambulance (n=97)</b>						156.73
	<b>Fire (n=113)</b>	4257.00	-2.793	0.005	Yes	Yes	94.67
	<b>Ambulance (n=97)</b>						118.11

FT.157

**South Wales Police****Fleet Management Only****Accident Reference No.....**Report of Accident or Damage InvolvingPolice Vehicles / Police Personnel**Log Book Correct Y / N****Reversing Aid Fitted Y / N****Data Recorder Fitted Y / N****Damage only**   **Accidents** (tick boxes that apply)

Damage Found	On Police Premises	Routine Patrol	Response	Pursuit/Follow	Private Car (Only if in Receipt of car allowance)

**Details of Accident / Damage**

Time (24hr)	Day/Date	Exact Location (e.g. Street name, Road number etc)	Division	Sector

**Police Driver (circle)**

Blameworthy	Yes	No	Suspended	Yes	No	Breath Test Result	Negative	Positive	Refusal
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**Damage (circle)****Injuries (circle)**

None	Slight	Serious		None	Slight	Serious	Fatal
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*Circumstances of Accident***Manoeuvre / Causation of Police Vehicle (circle those applicable)**

Rammed (Intentional)	Member of public Collides with Police/veh.	At traffic lights	At junction	Manoeuvring
At/On roundabout	On bend	Reversing	Other (write in)	

**Brief summary of Facts from I.O. (continue on separate sheet if necessary)**

<p><b>Observations/Recommendations of I.O.</b></p>
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**Investigating Officer**

Rank	No	Name (BLOCK CAPITALS)	Division	Station/Sector

**Result (Admin use Only) (circle)**

7	14	Assessment	Driving Course	Court
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**Details of the Vehicles, Drivers & Pedestrians Involved**

Provide the following details in relation to the vehicle(s), driver(s) and pedestrians(s) involved in this accident.

The first column should relate to the police vehicle involved in the accident. The other columns may also relate to police vehicles but may alternatively relate to pedestrians or to vehicles owned by members of the public.

NO BOX SHOULD BE LEFT EMPTY; PLACE A DASH (-) IN ANY BOX THAT DOES NOT APPLY. For example, vehicle details would be inapplicable in cases where the second party was a pedestrian; driver details would not be required in the case of a pedestrian being injured or an unattended vehicle being damaged.

	Police Vehicle	2 <sup>nd</sup> Vehicle	3 <sup>rd</sup> Vehicle
Vehicle Make (eg,Vauxhall,Ford)			
Vehicle Model ( eg.Vectra,Mondeo)			
Vehicle Index Number (e.g. A123 BCD)			
Vehicle Removed from Service (Y/N)			
Was this Vehicle Stolen (Y/N)			
Number of Passengers ( Not the Driver)			
Number of Passengers Injured			
Brief Description of the Damage to the Vehicle by Investigating Officer.			

Fleet management to update after vehicle Checked by Garage Staff.			
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	<b>Police Driver</b>	<b>2<sup>nd</sup> Driver/Pedestrian</b>	<b>3<sup>rd</sup> Driver/Pedestrian</b>
Name			
Age (Date of Birth, if Possible)			
Address			
Gender (M/F)			
Occupation (See Codes Below)			
Rank/Grade (Police Employees Only)			
Force Number (Police Employees Only)			
Div/Station/Dept (Police Employees Only)			
Driving Grade (Police Employees Only)			
Date of last Course or Assessment(M+Y)			
Length of Service(Police Employees Only)			
Was This Person Injured (Y/N)			
If Injured, Give a Brief Description of Injuries			
Driver Blameworthy (Y/N)	SEE OVER		
Breath Test t (Positive/Refused/Negative)	SEE OVER		

Occupation Codes (for use in the table above):

<b>For Police Employees:</b>  P1 Traffic Patrol; P2 Traffic ARV; P3 Traffic Motorway; P4 Traffic M/Cycle; P5 Traffic Other; P6 Div. Panda; P7 Div Van; P8 Div. CID; P9 Div. Other; P10 S.O.C.; P11 Buildings; P12 Driving School; P13 Other (Specify).
<b>For Members of the Public:</b>  N1 Professional; N2 Manual; N3 Retired; N4 Student; N5 Unemployed; N6 Other (Specify)

**CADW DE CYMRU'N DDIOGEL • KEEPING SOUTH WALES SAFE**



**Freedom of Information Request**

*Response date: 16<sup>th</sup> December 2016*

**How many G1 calls were responded to, in 2015, by month?**

**RESPONSE**

Please see below table that contains the requested data. Please find below the number of G1 incidents that were responded to during Jan-Oct 2015 inclusive.

There are only 10 months' worth of data due to the fact that South Wales Police changed their Command and Control systems for recording during November 2015 and therefore, data is held elsewhere and not comparable.

Year Month	Incidents
2015-10	8049
2015-09	7900
2015-08	8800
2015-07	8439
2015-06	7823
2015-05	7917
2015-04	7491
2015-03	7575
2015-02	6500
2015-01	7118

*THIS INFORMATION HAS BEEN PROVIDED IN RESPONSE TO A REQUEST UNDER THE FREEDOM OF INFORMATION ACT 2000, AND IS CORRECT AS AT THE DATE ORIGINALLY PROVIDED.*

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Prif Gwnstabl Peter Vaughan, O.St.J, QPM, BSc (Hons), DipAppCrim Chief Constable

<b>Police Force</b>	<b>a</b>	<b>b</b>	<b>c</b>	<b>d</b>
Avon And Somerset	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Bedfordshire	22	31	0	0
Cambridgeshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Cheshire *	50	Part of a.	17	Part of c.
City of London Police *	60	74	Part of a.	Part of b.
Cleveland	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Cumbria	25	9	0	1
Derbyshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Devon and Cornwall	160	87	12	8
Dorset	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Durham	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Dyfed Powys	6	20	2	1
Essex	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Gloucestershire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Greater Manchester	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Gwent	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Hampshire	120	109	14	27
Hertfordshire *	141	Part of a.	15	Part of c.
Humberside Police (2013 – 2014 only)	8	11	0	0
Kent	237	63	10	0
Lancashire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Leicestershire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Lincolnshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Merseyside	No response	No response	No response	No response
Metropolitan	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Norfolk	Data unavailable	Data unavailable	Data unavailable	Data unavailable
North Wales	Data unavailable	Data unavailable	Data unavailable	Data unavailable
North Yorkshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Northamptonshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable

Northumbria	223	129	63	65
Nottinghamshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Police Scotland	Data unavailable	Data unavailable	Data unavailable	Data unavailable
South Yorkshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Staffordshire	31	81	2	23
Suffolk Constabulary *	10	6	Part of a.	Part of b.
Surrey	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Sussex	No response	No response	No response	No response
Thames Valley	50	64	2	3
Warwickshire	27	19	3	11
West Mercia	18	14	5	3
West Midlands	No response	No response	No response	No response
West Yorkshire	Data unavailable	Data unavailable	Data unavailable	Data unavailable
Wiltshire	No response	No response	No response	No response

\* Separate figures are not kept regarding liability

**Unmarked Police vehicle collisions Hit 3<sup>rd</sup> party whilst on an emergency call**

Date	Time	Initial Fleet Detail	Flashing H/Lights	Beacon (Blue Lights)	Siren
14 <sup>th</sup> February	11:05	Officer on patrol heading between Junctions when he aquaplaned on a patch of water. Vehicle collided offside with the central reservation, back into live lanes and clipped member of the public.	No info	No info	No info
19 <sup>th</sup> February	00:04	Officer attending 999 call. As officer approached junction of Waterloo road the traffic lights were on red against him. He states he slowed down on approach and looks to his left and sees 3 <sup>rd</sup> party. Could not stop in time.	No	No	No
19 <sup>th</sup> February	11:50	Both Vehicle were negotiating roundabout when both vehicles collided.	No	No	No
18 <sup>th</sup> April	17:34	Vehicles collided at Traffic Signals.	No	No	No
25 <sup>th</sup> April	14:30	Officer approaching Junction at exit 35. He saw the vehicle in front move off then he suddenly stopped causing officer to hit the rear of the vehicle.	No	No	No
9 <sup>th</sup> May	21:10	Officer responding to a report of a serious house fire, mounted the pavement and thinking the Ambulance had passed opened rear off side door which then hit the Ambulance.	No	No	No
23 <sup>rd</sup> July	12:40	Officer responding to road traffic collision, Blues and Two's displayed. Members of Public mounted the kerb for officer to driver through but made contact with near side.	No info	No info	No info
6 <sup>th</sup> September	08:01	Cyclist in process of negotiating roundabout and indicated to turn right when Police vehicle entered the roundabout and hit the cyclist.	No	No	No
7 <sup>th</sup> September	00:10	Officers en-route to execute drugs warrant and as they approached the address the suspect person was sighted. He was chased on	No	No	No

		foot but then ran from pavement into road and collided with the front of the Police car.				
18 <sup>th</sup> October	23:56	Both Police vehicles attended a domestic incident. An aggressive non – compliant in rear of Mercedes drew attention which resulted in the vehicle rolling towards the Police Vehicle.	No	No	No	
15 <sup>th</sup> November	13:45	Vehicle 1 collides with Vehicle 2 whilst believing Vehicle 2 had entered the roundabout.	No info	No info	No info	

**Marked Police vehicle collisions Hit 3<sup>rd</sup> party whilst on an emergency call**

Date	Time	Initial Fleet Detail	Flashing H/Lights	Beacon (Blue lights)	Siren
29 <sup>th</sup> December	14.00	Officer following subject but then hit them.	No	No	No
29 <sup>th</sup> November	01.00	Officer responding to a call, came to a stop, reversed and hit taxi behind.	No	No	No
8 <sup>th</sup> November	20.00	Officer on emergency response came into contact with 14yr old youth who did not move quick enough. Father said having problems with victim.	No	Yes	Yes
24 <sup>th</sup> October	20.00	Officer en-route to emergency, blues and two's on. As the Van approached the same junction 3 <sup>rd</sup> party came to a stop. Officer thought he had stopped to let him pass. He moved to the wrong side of the road and collided.	Yes	Yes	Yes
13 <sup>th</sup> October	12.17	Officer travelling west en-route to an immediate response, travelling along wrong side of road to overtake slow traffic and misjudged position of 3 <sup>rd</sup> party. Collision occurred.	Yes	Yes	No
7 <sup>th</sup> October	19.05	Officer and cyclist collided as officer exiting station on an emergency call.	No	No	No
7 <sup>th</sup> October	17.45	Officer stationary at lights notices an offence in opposite direction. Attempts to turn around and fails to notice vehicle 2 behind and collides.	No	No	No
2 <sup>nd</sup> October	10.45	Officer approaching traffic lights on G1 where member of the public was stationary. Officer states he pressed down on brake and also accelerator at the same time causing him to collide with the member of the public	Not on IR3+	Not on IR3+	Not on IR3+
6 <sup>th</sup> September	01.50	Officer witnesses a fight involving 4 males, fight is violent. Officer attempts to place his vehicle between	Yes	Yes	No

		aggressors. Alleged by injured party that vehicle struck his foot.			
12 <sup>th</sup> August	14.40	Officer attending a G1 call. Officer has not anticipated Vehicle 2 making a right turn. As officer approached vehicle 2 it commenced turning, officer overtook and struck offside of the vehicle.	Yes	Yes	Yes
17 <sup>th</sup> July	15.59	Officer responding to a response call, for reasons unknown the officer was travelling the wrong way down a one way street, gone through junction and struck a member of the public.	No	No	No
3 <sup>rd</sup> April	14.38	Officer attending a G1 whilst traveling along Cyncoed road. He negotiated offside bend then travelled on the incorrect side of the road colliding with a member of the public.	Yes	Yes	Yes
20 <sup>th</sup> April	22.21	Police responding to a G1 call, Member of the public exited roundabout to near side to allow the Police to make progress. At point of collision width of the road was restricted, Police vehicle clipped offside of member of the public's vehicle.	No	Yes	Yes
4 <sup>th</sup> April	16.23	Officer enroute to violent domestic, travelling along street which is one way divided by 2 separate lanes. Injured party runs out from between two parked cars in front of officer.	Yes	Yes	No
14 <sup>th</sup> March	17.27	Officer in progress of responding to G1 while in traffic. Several vehicles in front came to sudden stop, officer collided.	No	No	No
14 <sup>th</sup> March	11.48	Officer responding to immediate response, all emergency appliances activated. Member of the public negotiating roundabout and officer came into contact with member of the public.	Yes	Yes	Yes
29 <sup>th</sup> January	12.45	Officer was attending G1. Officer positioned offside of MOP. Unfortunately, the member of the public stopped behind to allow	Yes	Yes	Yes

		oncoming traffic to pass then proceeded to carry out right turn. Officer took avoiding action but collided with member of the public.			
16 <sup>th</sup> January	22.09	Officer responding to G1 incident. No emergency equipment was in use. Panda collided head on with member of the public's vehicle.	No	No	No
6 <sup>th</sup> January	17.35	Officers responding to Grade 1 call. No emergency equipment on. Came up behind Vehicle 2 and appears to have misjudged the position of V2 and collided.	No	No	No
13 <sup>th</sup> December	16.05	Officer responding at Traffic Lights with sirens and lights illuminated. Proceeded through. At the same moment a Land Rover was travelling south bound following another vehicle and collided with the Police Vehicle	Not on IR3+	Not on IR3+	Not on IR3+
25 <sup>th</sup> September	04.00	Officer attending an immediate response, vehicle came to a stop. FSP alighted, unbeknown to driver the RSP attempted to alight when driver began to move off and hit RSP.	Yes	No	Yes
23 <sup>rd</sup> January	10.29	Officer attending G1. Vehicle in front moved to the side. Officer moved forward but failed to notice another vehicle through junction. Lights and Sirens in operation.	Yes	Yes	Yes
4 <sup>th</sup> August	10.09	Officer responding to call. Overtaking vehicle and clipped wing mirror.	Yes	Yes	Yes
2 <sup>nd</sup> August	17.28	Officer attending a G1, whilst travelling over calming measure. Hub cap became dislodged and hit member of the public.	No	Yes	Yes
11 <sup>th</sup> March	17.35	Police vehicle attending an immediate response call. Collided with member of the public on roundabout.	Yes	Yes	No
20 <sup>th</sup> January	22.15	Responding to G1 and hit another Police vehicle.	No	Yes	No

2 <sup>nd</sup> April	13.40	Officer responding to G1 has passed a line of stationary cars. Member of the public tried to move out of the way, but Police vehicle made contact.	No	Yes	Yes
3 <sup>rd</sup> June	08.33	On response call, came to traffic lights which were against officer but went through. Member of the public tried to stop in time but could not.	Yes	Yes	Yes
1 <sup>st</sup> June	10.25	Officer travelling through the village on response, traffic ahead stopped. Officer braked hard but unable to stop in time and hit rear of member of the public's vehicle.	No	No	No
6 <sup>th</sup> April	15.30	Officer in response and whilst passing traffic collided with Vehicle in stationary traffic.	No	No	No
3 <sup>rd</sup> August	11.00	Officer responding to G1, Milk Float short distance ahead. Both collided. Milk float did not hear sirens and officer did not see indicator.	Yes	No	Yes
20 <sup>th</sup> July	00.10	Officer in pursuit of stolen vehicle and stopped behind to apprehend offenders. Officer believed the vehicle was in park but moved forward and collided with suspect vehicle.	Yes	Yes	No
31 <sup>st</sup> August	11.31	Officer attending a response call, approaching lights and a vehicle from the right has stopped. A 2 <sup>nd</sup> vehicle continued to travel from the right crossing path of Police vehicle where both collided.	Yes	Yes	Yes
26 <sup>th</sup> September	14.30	Officer attending a G1. As officer reached junction lights which were on red and others green, a member of the public came through. Officer continued at low speed and collided with the member of the public.	Yes	Yes	Yes
20 <sup>th</sup> September	15.17	Officer on response call collided with 2 members of the public in junction.	Yes	Yes	Yes
8 <sup>th</sup> November	13.10	Officer on response call. Vehicle 2 parked on/off pavement. As officer passed nearside wing mirror collided with vehicle 2.	No Info	No Info	No Info

			Officer on response to incident in Lane 2, officer travels between on/off slip road and traffic ahead slowed. Officer reacted to traffic but collided with rear nearside of vehicle 2 which then collided with Vehicle 3.	Yes	Yes	No
29 <sup>th</sup> November	18.11		Attending a G1, wing mirror collided with member of the public's vehicle.	No	No	No
4 <sup>th</sup> January	15.40		On G1. He misjudged the position of another car and wing mirror collided.	Yes	No	No
18 <sup>th</sup> May	18.03		Officer on response call and intended to go across the Traffic lights which were red. Bus had stopped for him to pass and then collided with a member of the public.	Yes	Yes	Yes
9 <sup>th</sup> May	09.20		Responding to a G1 a refuse truck had parked in the road. Officer slowed to pass it but clipped the wing mirror.	Yes	Yes	Yes
14 <sup>th</sup> August	15.44		Subject vehicle involved in pursuit and Police vehicle contravened red light. Made contact with third party.	No Info	No Info	No Info
10 <sup>th</sup> August	09.40		Officer attending an immediate response. On approaching the junction, the officer made eye contact with the member of the public and believed she was going to give way but didn't and the collision occurred.	Yes	Yes	No
22 <sup>nd</sup> July	16.35		Whilst the officer was stationary in traffic he had an emergency response call. In order to pass the front vehicle, the officer reversed and collided with the vehicle behind.	No Info	No Info	No Info
30 <sup>th</sup> July	14.15		Officer responding to incident and as he entered the road he was confronted by a vehicle. In hesitation both vehicles moved at the same time and collided.	No	No	No
16 <sup>th</sup> September	02.24		Whilst dealing with an incident the officer sighted 2 suspects so whilst reversing collided with vehicle 2.	Yes	Yes	No

18 <sup>th</sup> September	17.30	Officer en route to a response incident and hit member of the public's vehicle.	Yes	Yes	Yes
21 <sup>st</sup> November	20.09	Officer in stop start traffic and noticed two males acting suspiciously then collided with the vehicle in front.	No	No	No
13 <sup>th</sup> June	03.38	Officer on G1 call and drove on to pedestrian areas to stop fight but as he braked hard, he slid and hit a 3 <sup>rd</sup> party.	Yes	Yes	Yes
21 <sup>st</sup> July	20.20	Officer attending an address to make an urgent arrest. Officer braked suddenly when leaving yard as he saw a child but hit the grille on the gate.	No	No	No
1 <sup>st</sup> July	12.00	Officer en route to an immediate response and passing vehicle on his offside. Hit member of the public.	No Info	No Info	No Info
25 <sup>th</sup> June	17.00	Officer on G1 call and parked vehicle on fairly steep incline. It appears the handbrake may have cooled and as a result the Police vehicle rolled back and hit a parked vehicle.	Yes	Yes	Yes
15 <sup>th</sup> August	13.20	Officer on G1 but slowed to pass bus and as he did, he clipped wing mirror.	Yes	Yes	Yes
1 <sup>st</sup> May	10.33	As Officer was responding to the G1 incident and as vehicle manoeuvring though 2 lanes of heavy stationary traffic it hit nearside wing mirror of passing vehicle.	No	No	No
3 <sup>rd</sup> May	10.15	Whilst travelling along stormy way officer completed a turn in the road and collided with a car.	No Info	No Info	No Info
13 <sup>th</sup> May	08.25	Officer enroute to broken down vehicle on the West bound carriageway when vehicle in front suddenly stopped.	Yes	Yes	Yes
13 <sup>th</sup> May	18.55	Police vehicle and Mop both intended to turn left. Police vehicle on G1 call collided with member of the public.	Yes	Yes	Yes

28 <sup>th</sup> July	14.45	Police vehicle collides with mop whilst turning at lights.	No	No	No
23 <sup>rd</sup> February	22.50	Officer accelerates to investigate vehicle however member of the public is turning right, and officer collides with the vehicle.	No	No	No
12 <sup>th</sup> February	08.58	Officer responding to G1 along dual carriageway during rush hour and was attempting to filter, in doing so wing mirror collided with stationary vehicle.	Yes	Yes	No
13 <sup>th</sup> December	08.15	Officer responding to G1 call, emergency equipment in use, lights were red for officer and green for the public. Both continued and collided.	No	Yes	Yes
19 <sup>th</sup> December	21.55	Officer involved in a fast Ambulance escort conveying a critically injured Male, as vehicle is approaching lights Ambulance spotted another vehicle and braked, Police Vehicle collided.	Yes	No	Yes
6 <sup>th</sup> November	12.30	Vehicle involved in pursuits and had spun on two occasions. It was just pulling off after a spin when he saw a member of the public ahead so tried to push vehicle towards ditch but made contact with them.	Yes	Yes	No
1 <sup>st</sup> August	09.30	Whilst all three vehicles were driving along M4 BMW Vehicle 3 has swerved in Vehicle 1 Police vehicle whilst avoiding a collision with vehicle 2 which had a blowout.	No	No	No
12 <sup>th</sup> July	16.40	Two Police vehicle responding to G1 call, the first vehicle stopped due to the actions of the member of the public, second police vehicle also responding failed to stop and collided with the rear of the Police car in front.	Yes	Yes	Yes
19 <sup>th</sup> July	00.00	Officer responding to G1 with emergency equipment in use. Travelled through red light when Mop traveling through green light collided.	Yes	Yes	Yes
1 <sup>st</sup> June	01.14	Officer drove forward to block in suspect vehicle but made slight contact.	No	No	No

27 <sup>th</sup> June	13.40	Officer on G1 response when he collided with parked and unattended vehicle.	No Info	No Info	No Info
10 <sup>th</sup> February	22.15	Officer on response call whilst traveling past parked vehicle. Officer clipped offside of taxi.	No	No	No
5 <sup>th</sup> April	21.31	Officer enroute to an emergency came to junction. Proceeded across at slow speed. Another vehicle came from RHS. Slowed down but both moved together and both collided.	No	Yes	No
10 <sup>th</sup> April		Officer left station on G1 call and collided with vehicle in adjoining bay. Collision would not have occurred if vehicle was not obstructing the exit.	Yes	Yes	Yes
1 <sup>st</sup> May	21.30	Officer on emergency call and stopped to talk to male who made off on foot. Officer drove out of car park but skidded and collided with member of the public.	No	No	No
15 <sup>th</sup> May	18.08	Officer responding to G1 with Blues and Two's illuminated, as a member of the public appeared from around the bend the officer pulled out and struck the vehicle.	Yes	Yes	Yes
15 <sup>th</sup> May	07.27	Officer enroute to G1 and while negotiating a junction against a red light at slow speed the officer came into collision with a Motorcyclist who was travelling through the junction.	Yes	Yes	No
16 <sup>th</sup> May	07.31	Officer enroute to immediate response, officer in outside lane of 3 and approached a build-up of traffic so slowed. Vehicle 2 moved out but directly into the path of the officer.	Yes	Yes	Yes
3 <sup>rd</sup> January	19.20	Officer on routine patrol when police vehicle on immediate response coming in the opposite direction. She pulled over but both cars collided.	No	No	No
19 <sup>th</sup> January	13.25	Officer responding to G1 when vehicle in front unaware of the Police vehicle started turning right and as he did so the Police vehicle collided.	No Info	No Info	No Info

			Officer responding to G1 when confronted by an oncoming vehicle in narrow road. Passed slowly but the Police vehicle grazed the member of the public's vehicle.	Yes	Yes	Yes
31 <sup>st</sup> January	17.30	01.30	Officer on response to a Burglary in progress in a narrow street. Whilst doing so he had a collision with a parked an unattended vehicle.	Yes	No	No
24 <sup>th</sup> June	04.40		Officer on immediate response and passed address so reversed a short distance, checked mirrors but did not notice the member of the public behind.	No	No	No
15 <sup>th</sup> February	16.26		Officer attending a disturbance checked the mirrors and could not see anything so began to reverse but hit the member of the public behind	No	No	No
6 <sup>th</sup> March	23.15		Officer engaged reverse due to call. Checked his mirrors but still hit the member of the public behind.	No	Yes	No

(Highlighted words are those identified within themes by NVivo v11).

### Unmarked Police vehicle collisions Hit by 3<sup>rd</sup> party whilst on an emergency call

Date	Time	Initial Fleet Detail	Flashing H/Lights	Beacon (Blue lights)	Siren
6 <sup>th</sup> January	07:40	Whilst officer brought to a standstill in a queue another vehicle collided into the rear.	No info	No info	No info
7 <sup>th</sup> January	09:50	Stolen Ford Fiesta failed to stop for Police and made off. It was then sighted, and Fiesta forced its way around rear of the Police Van, sped through red lights and collided with a member of the public.	No	No	No
28 <sup>th</sup> January	17:27	All 3 vehicles travelling along road when vehicle 3 collided with vehicle 2 which then collided with vehicle 1.	No info	No info	No info
14 <sup>th</sup> April	22:10	Officer in unmarked Police vehicle assisting other officers when MOP pulled to the near side for marked vehicle and collided with unmarked vehicle.	No	No	No
19 <sup>th</sup> April	13:40	Police vehicle travelling in Lane 3, vehicle 2 overtaking vehicle 1 when heavy goods vehicle (HGV) pulled into Lane 2 causing vehicle 2 to swerve, lose control and rebound off central reservation before crashing to Police vehicle.	No info	No info	No info
6 <sup>th</sup> May	22:30	A pre-emptive tactic was deployed on a stolen vehicle where it collided with front of vehicle 2 and rear of vehicle 1.	No	Yes	No
17 <sup>th</sup> May	16:50	Officers dealing with separate incident, vehicle parked and switched off. Driver of Vehicle 2 moved around Police vehicle where it hit the front off side.	No info	No info	No info
22 <sup>nd</sup> May	12:55	Officer in pursuit, vehicle failed to stop and intentionally reversed at speed and its rear end collided with front of officer's vehicle.	Yes	Yes	Yes
13 <sup>th</sup> June	11:50	Police vehicle attended a road traffic collision, also in attendance West Wales Fire Service who positioned tender directly behind Police vehicle. Once incident dealt with Fire Officer prepared to move off but rolled into Police Vehicle.	Yes	Yes	No

6 <sup>th</sup> July	13:20	Officer driving in heavy traffic and an unknown silver car from the opposite direction came into contact.	No	No	No
30 <sup>th</sup> July	21:20	Covert vehicle involved in pre-emptive TPAC Manoeuvre on suspect vehicle when subject was seen to panic and swerved hitting Police vehicle.	Yes	Yes	No
5 <sup>th</sup> August	18:45	Member of public running from Police ran into Police vehicle.	No info	No info	No info
9 <sup>th</sup> August	11:08	Whilst going around the roundabout the offending vehicle entered into lane and came into contact with Police vehicle.	No info	No info	No info
16 <sup>th</sup> August	11:55	As officer began to move member of public reversed back and hit Police vehicle.	No	No	No
27 <sup>th</sup> August	14:49	Parked behind suspect vehicle. Suspect vehicle reversed and collided.	No	No	No
1 <sup>st</sup> September	15:50	Both vehicles engaged in authorised covert. Vehicle 2 behind target. Vehicle 2 overtook vehicle 1 and collision occurred.	No info	No info	No info
1 <sup>st</sup> November	16:30	On operation officer slowed to turn left. The motorcyclist accelerated whilst rider was looking behind and rode into the back of the Police vehicle.	No info	No info	No info
16 <sup>th</sup> November	17:20	Officer was travelling in outside lane. Arctic pulling trailer collided with the nearside.	No info	No info	No info
19 <sup>th</sup> November	10:00	Unmarked Police vehicle travelling along carriageway when member of the public pulled out.	No info	No info	No info
2 <sup>nd</sup> December	16.19	Officer in Lane 3, Member of the public in Lane 2 when he moved out into Lane 3 striking the PV. Officer swerved to avoid collision and hit central reservation.	No info	No info	No info
15 <sup>th</sup> December	03:40	Officer waiting at Traffic lights behind offending vehicle when he reversed and hit Police vehicle. Driver arrested and breathalysed.	No	No	No
15 <sup>th</sup> December	16:25	Officer held at Junction when vehicle behind thought he moved off and in doing so collided with the Police vehicle.	No info	No info	No info

**Marked Police vehicle collisions Hit by a 3<sup>rd</sup> party whilst on an emergency call**

Date	Time	Initial Fleet Detail	Flashing H/Lights	Beacon (Blue lights)	Siren
23 <sup>rd</sup> January	14.30	Whilst conducting an <b>enforced stop</b> the offender deliberately reversed his vehicle into the Police Vehicle.	No Info	No Info	No info
10 <sup>th</sup> February	15.30	As both vehicles approached the Exit the member of the public collided with the Police vehicle.	No	No	No
12 <sup>th</sup> February	00.20	Officer <b>observing suspects</b> who got into vehicle, suspects drive off, Police vehicle stopped behind them and suspects reversed into Police vehicle.	No Info	No Info	No Info
9 <sup>th</sup> March	14.00	Member of the public travelling behind the officer and failed to notice the vehicle stopped to turn right and collides heavily with the Police vehicle.	Yes	Yes	Yes
14 <sup>th</sup> May	08.35	RP states Police vehicle with emergency lighting travelled around the bend at 50mph overtaking vehicles, entered lane which caused him to brake sharply. Collision with member of the public.	Yes	Yes	Yes
20 <sup>th</sup> May	08.39	Police vehicle stopped as vehicle ahead stopped. Vehicle 2 stopped behind Police vehicle but vehicle 3 failed to stop and then collided with V2 which in turn collided with the Police vehicle.	No	No	No
23 <sup>rd</sup> May	10.00	Nearside wing mirror smashed by passing unknown vehicle and by persons unknown.	No	No	No
26 <sup>th</sup> May	22.00	<b>Suspect vehicle</b> driven on wrong side of road and then drive head on into stationary police vehicle.	No	No	No
4 <sup>th</sup> June	02.09	Officer in <b>short pursuit</b> where subjects decamped vehicle and it started to roll. Officers positioned their vehicle to prevent it rolling further down the hill.	No	No	No
11 <sup>th</sup> July	16.10	Police vehicle following coach and approached him with the intention of speaking to him regards to a traffic offence. As the officer came over the	No Info	No Info	No Info

		Front nearside of the coach pulled forward and came into contact.		
14 <sup>th</sup> August	16.45	Officer responding to G1, emergency lighting and sirens activated. As officers negotiated the bus lane, member of the public heard sirens but could not see the vehicle and reacted by moving into the bus lane and made contact with the Police vehicle.	No Info	No Info      No Info
17 <sup>th</sup> August	15.54	Officer responding to a G1. As officer approached garage the member of the public pulled over to let him pass. As he did so a 2 <sup>nd</sup> car emerged from the garage car park turned left and collided with the Police vehicle.	Yes	Yes      No
19 <sup>th</sup> November	00.33	Member of the public failed to stop for officers and officers then carried out a <b>tactical manoeuvre</b> to bring the pursuit to a safe conclusion.	No	Yes      No
8 <sup>th</sup> December	19.53	Officer on emergency response travelling towards lights that were on green, member of the public at red lights heard sirens and both cars collided.	Yes	Yes      No
10 <sup>th</sup> December	15.40	Officer responding to an emergency overtaking slow moving vehicles when vehicle failed to look and proceeded to overtake a slower moving vehicle in front of the Police.	No Info	No Info      No Info
18 <sup>th</sup> December	12.00	Male wanted for several offences collided with the Police vehicle on his bike causing damage to the Police vehicle.	Yes	No      No
29 <sup>th</sup> December	10.50	Officer indicated for a vehicle to stop, in process of him parking he reversed into the Police vehicle due to a misted up windscreen.	Yes	Yes      Yes
9 <sup>th</sup> January	17.23	Officer on response with all emergency equipment activated, the traffic lights were showing red for the officer and she slowly drove noting the vehicle to the offside. Member of the public did not see until it was too late.	Yes	Yes      Yes
15 <sup>th</sup> February	15.00	Officer in <b>ongoing pursuit</b> , offending vehicle overtook a line of traffic crossing over into oncoming traffic. Police vehicle was then struck by towed trailer of offending vehicle.	No	No      No

			Police vehicle intending to stop non-roadworthy motorcycle ridden by 15 year old male. Rider had no brakes and collided with the nearside of the Police Vehicle.	Yes	Yes	No
1 <sup>st</sup> March	17.35		Officer responding to an emergency when a vehicle in the wrong lane collided with the Police vehicle.	No	No	No
13 <sup>th</sup> March	03.20		Officer attended to reports of a suspicious vehicle and drove towards the subject. Unknown driver attempted to drive around the Police vehicle but reversed and rammed it 4 times.	No Info	No Info	No Info
17 <sup>th</sup> March	22.17		Police vehicle stopped directly behind subject vehicle in which they started the engine and reversed in an attempt to make off which resulted in a collision with the Police vehicle.	No	No	No
18 <sup>th</sup> March	22.50		Police vehicle stationary when a silver Astra intentionally reversed into the Police vehicle.	No Info	No Info	No Info
23 <sup>rd</sup> March	02.30		Fiesta reversed in an attempt to evade the Police and collided with the front of the patrol car.	No	No	No
27 <sup>th</sup> April	16.25		Officer responding to G1, Traffic ahead reacted and officer began to overtake when member of the public was distracted in her car by her 3 year old. She failed to notice the traffic slowing and collided with the Police vehicle.	No	No	No
15 <sup>th</sup> May	12.17		Member of public emerged from give way junction and collided with the Police on a G1 call.	No Info	No Info	No Info
4 <sup>th</sup> September	08.00		Officer arrived at RTC and member of public attempted to pass but collided with the Police vehicle.	No Info	No Info	No Info
8 <sup>th</sup> August	03.40		Officer going through the traffic lights in sequence when a Taxi came from the nearside and collided.	Yes	Yes	No
4 <sup>th</sup> October	18.25		Local PSV collided with the Police vehicle which was parked with emergency lights on.	Yes	Yes	NO

23rd October	14.15	On immediate response on the on slip. Blue lights activated. Lorry driver collided with the Police vehicle.	No Info	No Info	No Info
1st September	02.20	Officer following suspect vehicle when it stopped outside an address. The driver alighted and in doing so the suspect vehicle rolled back and collided with the Police vehicle.	No	No	No
11th August	21.20	Officer patrolling area in search of culprit when a Quad lost control and collided with the Police vehicle.	Yes	Yes	No
21 <sup>st</sup> June	23.15	Officer on route to response call, Vehicle 1 tried to pull to nearside to let officer pass but realised there was not enough room, reversed and hit the Police Vehicle.	Yes	Yes	Yes
10 <sup>th</sup> May	14.38	Vehicle 1 stopped and indicated right, notice the Police vehicle but as she turned left failed to see the Police vehicle had stopped and collided with it.	No	No	No
10 <sup>th</sup> May	16.55	On way to G1 when driving through a single lane at low speed. Vehicle 2 was travelling through same lane and speed and collided.	No	No	No
21 <sup>st</sup> March	21.55	Responding to emergency. Approached the traffic lights, slowed down as member of public travelled from offside. Saw Police vehicle but was unable to stop in time and made contact with the rear of the Police vehicle.	Ye	Yes	Yes
16 <sup>th</sup> March	11.10	Responding to incident and was behind traffic when a bus moved and collided with rear nearside of the Police vehicle.	No	No	Yes
4 <sup>th</sup> March	21.00	Officer responding to the report of a sighting when a member of public reversed out of a blind driveway and into the path of a Police vehicle.	No Info	No Info	No Info
19 <sup>th</sup> January	00.30	As 2 Police vehicles responded to an emergency an intoxicated pedestrian ran out into the side of the first Police vehicle. As a result, the vehicle performed an emergency stop and vehicle 2 collided with the rear.	Yes	Yes	No
22 <sup>nd</sup> August	19.04	Officer responding to G1, member of public commits to a U turn and hit offside rear of the Police vehicle.	Yes	No	Yes

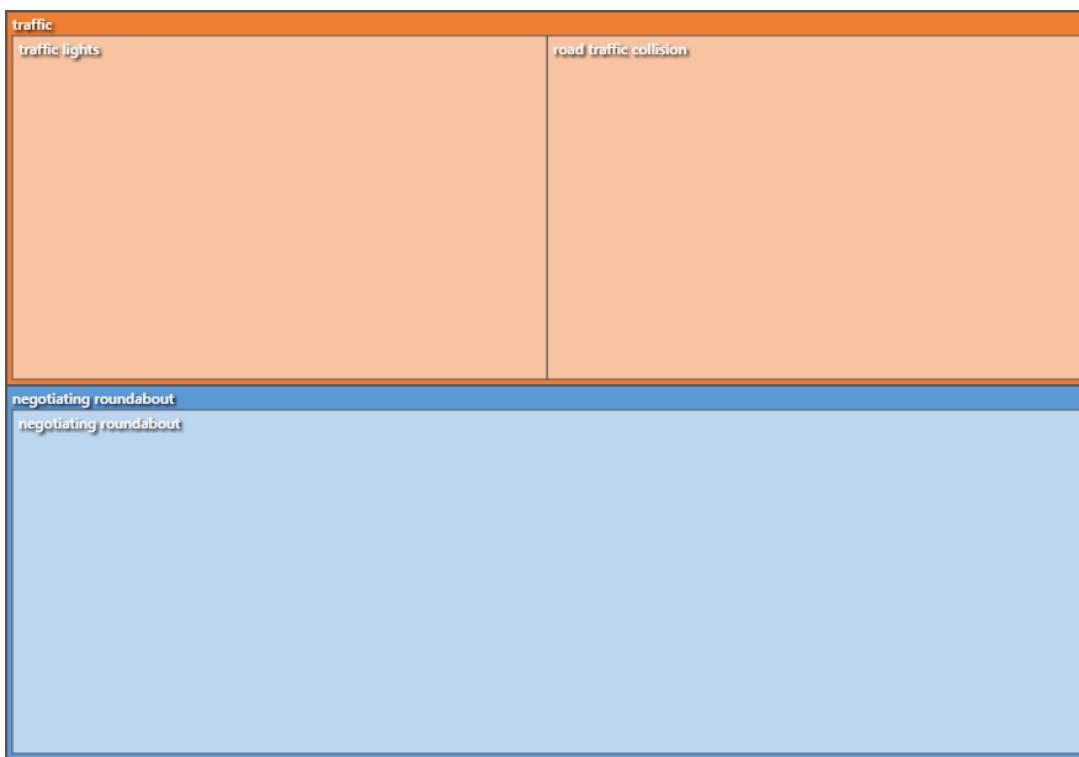
22 <sup>nd</sup> August	20.01	Officer responded to G1. MOP failed to see them and hit rear of Police vehicle.	Yes	No	Yes
25 <sup>th</sup> July	08.42	Police vehicle protecting vehicle 3 who had broken down in Lane 1, light illuminated. Vehicle 1 travelling in same direction accelerated not realising Police vehicle was stationary therefore colliding with rear.	No	No	No
28 <sup>th</sup> July	20.00	Officer pulled into dead end street to talk to suspect rider. Throttle jammed and hit the Police vehicle.	No	No	No
16 <sup>th</sup> June	01.12	Officer in response to drunk driver, suspect appeared from a blind right hand bend on wrong side and hit the Police vehicle head on.	No	No	No
10 <sup>th</sup> April	18.33	Patrol car attending immediate response and passing stationary cars at lights when MOP suddenly turned right causing extensive damage.	Yes	Yes	Yes
8 <sup>th</sup> March	15.16	Officer in response to G1 when at roundabout the member of public moved into nearside lane and hit officer. Lights and sirens on.	Yes	Yes	Yes
2 <sup>nd</sup> March	11.57	Officer positioned vehicle behind collision. Vehicle 2 out in front of Vehicle 3 at roundabout. Vehicle 3 then vehicle 2 pushed into Police vehicle.	No	No	No
27 <sup>th</sup> February	05.55	Member of public collided with the central reservation. Officer signalled to stop. <b>Pursuit authorised</b> . Hit reservation then Police vehicle.	No	Yes	No
14 <sup>th</sup> February	20.10	Officer attending a G1, coming up to a vehicle who slowed and pulled into nearside. As officer overtook vehicle it decided to turn right across the Police vehicle path.	Yes	Yes	Yes
15 <sup>th</sup> June	14.39	Officer parked to assist traffic congestion as a result of a funeral. Elderly male clipped wing mirror.	No	No	No
21 <sup>st</sup> January	19.35	Police vehicle protecting the road closure with lights on. Member of public turned her vehicle and hit the police vehicle.	No	Yes	No

10 <sup>th</sup> January	02.52	Vehicle failed to stop	No	Yes	No
14 <sup>th</sup> January	15.50	On G1, whilst stationary at crown of road an unknown blue transit hit the wing mirror.	No Info	No Info	No Info
30 <sup>th</sup> December	14.30	Officer driving towards the high street when the member of public moved from a parked position and hit the Police vehicle.	No	Yes	No
20 <sup>th</sup> November	19.15	As officer pulled up behind the offending vehicle to speak to the driver, vehicle 2 stopped without warning and a collision occurred.	No	No	No
1 <sup>st</sup> October	03.30	Officers attending an incident saw vehicle being driven at speed in a dead end. He did a handbrake turn and sped directly at the Police colliding with the nearside wing and hit 2 Police cars.	Yes	Yes	No
4 <sup>th</sup> April	17.35	Officer in pursuit of stolen ford fiesta, officer pulled along its offside in an attempt to block the driver, but the vehicle reversed and caused damage to the Police vehicle.	Yes	Yes	Yes
8 <sup>th</sup> March	10.59	Officer responding to Alpha 1, overtaking vehicles, the collision involved oncoming vehicles. Vehicle 2 brought hers to a stop for officer to pass, as vehicle 3 looked in rearview mirror then vehicle 2 collided with the rear.	Yes	Yes	Yes
5 <sup>th</sup> March	11.45	Officer responding to G1, traffic slowed for the Police which collided with the offside wing mirror stationary on traffic.	Yes	Yes	Yes
11 <sup>th</sup> March	01.34	After short follow of what was an OSSV, driver abandoned vehicle on an uphill gradient. Vehicle rolled back and made a glancing contact with the Police vehicle.	No	Yes	No
19 <sup>th</sup> December	14.40	Officer attending the scene of an RTC, Police vehicle correctly positioned with emergency lighting illuminated. Officer out of the vehicle when a member of public through inattention drove into rear offside of the Police vehicle.	No	No	No

22 <sup>nd</sup> May	18.00	Officer engaged in <b>tactical pursuit</b> , officer got out of the vehicle to apprehend the driver, subject then collided with member of public and rammed the Police vehicle.	Yes	Yes	No
No date	04.42	At conclusion of a <b>tactical pursuit</b> the subject vehicle was cornered in a cul de sac. Driver attempted to get past but made contact on the vehicle.	Yes	Yes	Yes
1 <sup>st</sup> February	00.55	Officer in <b>authorised pursuit</b> with subject vehicle which collided lightly with parked and unattended vehicle. Subject vehicle continued taking the roundabout on the wrong side. Police Vehicle damage.	Yes	Yes	Yes
4 <sup>th</sup> May	00.15	Officers sat in stationary Police vehicle – Blue Lights were on. As moving off a G1 Police vehicle passed and made contact with the rear.	No	No	No

(Highlighted words are those identified within themes by NVivo v11).

### NVivo hierarchy analysis of “Themes” - Unmarked vehicles which hit a third party.



### NVivo hierarchy analysis of “Themes” - Marked Vehicles which hit a third party.



**NVivo hierarchy analysis of “Themes” - Unmarked vehicles which were hit by a third party.**

vehicle	suspect vehicle	unmarked vehicle	overtaking vehicle	offending vehicle	marked vehicle
police vehicle	heavy goods vehicle			causing vehicle	2 overtook vehicle
	covert vehicle				

**NVivo hierarchy analysis of “Themes” - Marked Vehicles hit by a third party.**

vehicle	50mph overtaking vehicles	offending vehicle ov...	vehicle ...	vehicle ...	unkno...	car	garage car park	2nd car
vehicle path		unattended...	suspicious v...	saw vehicle	saw police...	stationary cars	2 police cars	
suspect vehicle		realising police Vehicle	moving vehic...	decamped v...		patrol car		
oncoming vehicles		protecting vehicle		abandoned vehicle				
officer overtook vehicle		positioned vehicle		2 police vehicles		lane	entered lane	nearside lane
							wrong lane	bus lane
							single lane	

CADW DE CYMRU'N DDIOGEL • KEEPING SOUTH WALES SAFE



Freedom of Information Request 325/19

Response Date: 4<sup>th</sup> April 2019

Could you please confirm (in total) how many vehicles are classed as:

Marked Response - cars

Unmarked / Covert - cars (fitted with emergency warning systems)

**RESPONSE**

There are 174 Marked Response cars and 34 Unmarked / Covert - cars (fitted with emergency warning systems)

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Mae Heddlu De Cymru yn croesawu cerbyd gohebaid yn Gymraeg a Saesneg  
Byddwn yn ateb gohebaid a ddebynnir yn Gymraeg yn Gymraeg ac ni fydd  
gohebu yn Gymraeg yn arwain at oedi.

South Wales Police welcomes receiving correspondence in Welsh and English.  
Any correspondence received in Welsh will be answered in Welsh and responding  
in Welsh will not lead to a delay in responding.

**UNMARKED POLICE VEHICLE  
ANPR DATA COLLECTION**

Ref	Video Duration (secs)	Blue Light Activation Duration (secs)	Event	Time of day /Location
1	131	131	No event	14:40 M/Way
2	264	Nil	No event	14.23 M/Way
3	49	Nil	No Event	14:22 M/Way
4	74	Nil	No Event	13:47 Urban Housing Estate
5	26	Nil	No Event	13:05 M/Way
6	29	Nil	No Event	13:02 M/Way
7	73	61	No Event	23:40 Dual
8	85	Nil	No Event	00:09 M/Way
9	115	Nil	No Event	12:14 M/Way
10	178	3	Vehicle stop for poor overtaking: No adverse event	21:30 City
11	714	13	Vehicle stopped for speeding: No adverse event	12:33 M/Way / Rural
12	216	Nil	No event	1.07 M/Way
13	557	50	Van pulled over for offence: No adverse event	20:04 M/Way
14	227	Nil	No Event	13:06 M/Way
15	73	73	No Event	20:53 Dual
16	74	74	1 car in lane 3 of 3. Did not notice approaching unmarked Police Vehicle with Lights operating. PV speed dropped from 100mph to 76mph before car moved to lane 2	20:54 M/Way (Dark)
17	191	191	No Event	1:09 Dual
18	82	Nil	No Event	20:19 City
19	116	Nil	No Event	20:22 City
20	73	Nil	No Event	20:26 City

<b>21</b>	49	Nil	No Event	12:27 Dual
<b>22</b>	34	Nil	No Event	12:29 M/Way
<b>23</b>	79	60	No Event	5:27 M/way
<b>24</b>	124	124	No Event	4:32 Dual and M/way
<b>25</b>	77	77	<b>Motorhome in Lane 3. Did not move over initially. Police Vehicle speed went from 113mph to 75mph before the Motorhome moved over to Lane 2</b>	<b>10:06</b> <b>M/Way</b>
<b>26</b>	117	117	No Event	22:56 M/Way
<b>27</b>	74	21	Vehicle pulled over for Speeding. No adverse event	20:54 City
<b>28</b>	72	72	<b>Late identification of the Police Vehicle whilst travelling in Lane 3. Police Vehicle speed went from 105mph to 80mh before the vehicle then moved to Lane 2</b>	<b>10:20</b> <b>M/Way</b>
<b>29</b>	80	80	No Event	10:05 M/Way
<b>30</b>	437	Nil	No Event	22:13 Dual
<b>31</b>	70	Nil	No Event	22:09 Dual
<b>32</b>	233	Nil	No Event	20:48 M/Way
<b>33</b>	58	Nil	No Event	18:23 A Road
<b>34</b>	72	72	No Event	20:45 Dual
<b>35</b>	160	Nil	No Event	13:03 M/Way
<b>36</b>	92	Nil	No Event	03:17 M/Way
<b>37</b>	703	703	No Event	01:20 M/Way
<b>5878 secs (1 hr, 37 min, 58 sec)</b>		<b>1922 secs (32 min, 02 sec)</b>		

**Total number of clips = 37 (Blue Light 17, Non Blue light 20)**

MARKED POLICE VEHICLE DATA CAPTURE (ANPR ONTO CD)					
	Video Duration (secs)	Blue Light Activation Duration (secs)	Event	Highest speed	Time of day /Location
1	115	115	No Event	125	22:16 Dual
2	833	Nil	No Event	55	02:41 Urban
3	72	72	No Event	120	00:03 M'Way
4	346	346	Vehicle already stopped	Nil	21:23 Urban
5	316	29	Pulled car over – No adverse reaction	99	21:44 M'Way
6	192	192	No Event	139	00:02 M'Way
7	69	69	No Event	121	22:38 Lit Dual
8	79	Nil	No event	121	00:00 M'Way
9	70	Nil	No Event	120	00:02 M'Way
10	70	70	One vehicle on single lane slip road. Looking for place to pull over to get out of the way but no adverse reaction	120 down to 63	15:33 M'Way
11	31	Nil	No Event	38	16:52 Urban
12	58	Nil	No Event	86	22:25 M'Way
13	41	NI	No Event	33	19:32 A' Road and Urban
14	125	125	Red Van Lane 3. Police (headlights but no blue lights) before moving over to lane 2 (time slot 1.34 – 1.42)	120 down to 70	15:36 M'Way
15	114	100	No event	128	23:24 M'Way Lit
16	115	108	No Event	115	22:17 Dual Lit
17	20	Nil	No event	88	21:43 M'Way
18	58	Nil	No event	88	21:45 M'Way
19	56	Nil	No event	88	21:42 M'Way
20	115	Nil	No Event	80	21:38 M'Way
21	26	26	No event	124	00:26 M'Way

<b>22</b>	845	Nil	No Event	35	11.02 Urban
<b>23</b>	418	Nil	No event: Followed a driver and then gave them a verbal warning at the end of the slip road for speeding	90	21:46 M'Way
<b>24</b>	77	77	Unlit M'Way. Vehicles moved to lane 1 and 2 early so no adverse events	120	22:41 M'Way
<b>25</b>	301	30	Driver pulled over when requested. No event	70	19:22 Dual Dusk
<b>26</b>	1810	Nil	No event	75	03:02 Dual/Urban
<b>27</b>	76	46	Pulled a vehicle over for speeding 80 in a 50. No adverse reaction. Driver signalled and stopped in a safe place	85	00:42 A Road
<b>28</b>	60	Nil	No Event	47	20:51 City
<b>29</b>	38	Nil	No Event	67	22:53 M'Way
<b>30</b>	73	73	No Event	120	22:50 Dual
<b>31</b>	88	88	No Event	127	22:47 Dual Lit
<b>32</b>	77	77	No event	120	00:02 Dual Lit
<b>33</b>	74	74	No Event	127	01:53 Dual Lit
<b>34</b>	53	Nil	No Event	80	22:01 M'Way
<b>35</b>	70	70	No event. All vehicles moved with only 10mph speed reduction from Police Vehicle	121	19:08 Dual Lit
<b>36</b>	103	103	No Event	136	19:09 Dual Lit
<b>37</b>	45	Nil	No Event	82	23:08 Dual Lit
<b>38</b>	74	5	PV used lights to get car to move from Lane 2 to Lane 1 due to lane hogging. No adverse reaction	73	22:18 M'Way
<b>39</b>	74	74	No Event	121	02:42 Dual Lit
<b>40</b>	71	71	No Event	122	01:03 Dual Lit
<b>41</b>	130	130	No Event	91	21:41 Dual Lit
<b>42</b>	74	74	No Event	127	01:42 Dual Lit
<b>43</b>	89	89	No Event	115	10:58 M'Way

<b>44</b>	84	Nil	No Event	60	21:44 Dual Lit
<b>45</b>	45	Nil	No Event	69	21:46 Dual Lit
<b>46</b>	413	413	No Event	145	23:16 M'Way/ Dual Lit
<b>47</b>	<b>1078</b>	<b>18</b>	<b>Pulled a vehicle over for suspected Drink Driving. Vehicle hit kerb as it came to rest. (Breath test failed)</b>	<b>60</b>	<b>23:54 Dual Lit</b>
<b>48</b>	138	17	Pulled a vehicle over. No adverse reaction	82	01:12 Dual Lit
<b>49</b>	146	13	Pulled a vehicle over. No adverse reaction	74	00:31 Dual Lit
<b>50</b>	238	15	Following a vehicle 30mph over the limit. Lights activated and vehicle pulled over straight away so no adverse reaction	86	21:47 Dual Lit
<b>51</b>	190	Nil	No event	35	23:20 Urban
<b>52</b>	168	Nil	No event	50	00:12 Dual
<b>53</b>	789	Nil	No event	86	00:14 Urban / Dual
<b>54</b>	442	Nil	No event	30	20:23 Urban
<b>55</b>	134	Nil	No event	108	23:06 Dual Lit
<b>56</b>	<b>79</b>	<b>79</b>	<b>Car and then van did not immediately notice.</b>	<b>126 down to 77</b>	<b>13:54 Dual</b>
<b>57</b>	301	Nil	No event	75	13:04 M'Way
58	84	84	No event	124	02:15 Dual Lit
59	87	Nil	No event	131	03:10 Dual Lit
60	74	74	No event	122	19:05 M'Way
<b>61</b>	68	68	No event	120	19:07 M'Way
<b>62</b>	1190	Nil	No event	63	03:32 A 'Road unlit
<b>63</b>	300	7	Lights used to ask a vehicle to stop which did so straight away. No adverse reaction	41	18:52 Urban
<b>64</b>	170	Nil	No event	89	21:27 Dual Lit
<b>65</b>	<b>121</b>	<b>64</b>	<b>Vehicle pursuit: Vehicle failed to stop then driver decamped on foot</b>	<b>45</b>	<b>02:20 Urban</b>
<b>66</b>	205	Nil	No event	64	22:53 Urban / Dual Lit

67	938	938	Car moved late to lane 2 (120s in to footage). 3 Police vehicles behind them. TPAC manoeuvre caused an HGV to brake hard due to Police error	126	12:31 Urban/ M'way
68	181	90	Vehicle failed to stop so pursuit commenced. Mounted pavement and crashed	60	23:21 Urban
69	292	167	Vehicle sped away when they realised a PV was behind them. Lights activated and eventually vehicle crashed into lamppost	47	21:34 Urban
70	241	241	(108s into footage). Vehicle starts move onto RH lane with near miss on PV. Vehicle subsequently pulled over by Police	118	21:50 Dual
71	85	85	Vehicle asked to pull over and did so safely without adverse incident	109	15:33 M'Way
72	91	91	No event	128	23:08 Dual Lit
73	76	76	Late reaction of cars in lane 2 which eventually moved to Lane 1	128 down to 68	10:44 Dual
74	69	69	No event	121	10:45 Dual
75	601	601	No event	103	13:02 M'Way
76	56	Nil	No event	95	13:46 M'Way
77	98	Nil	No event	123	00:03 M'Way
78	107	Nil	No event	86	18:52 Dual Lit
79	319	10	Sirens/Lights used to pull a vehicle over. Vehicle pulled over when safe for speeding 40 in a 30. No adverse driver reaction	64	17:28 Urban / Dual
80	271	22	Pulled over for erratic steering. No adverse reaction by driver when stopping	63	23:24 Dual Lit
81	82	Nil	No event	76	18:53 Dual Lit
82	137	137	No event	125	19:31 M'Way Lit
83	92	92	No event	121	14:16 M'Way Lit
84	31	Nil	No event	73	14:30 M'Way
85	70	70	No event	122	19:00 Dual Lit
86	80	80	No event	119	22:32 Dual Lit
87	76	76	No event	118	22:50 Dual Lit

<b>88</b>	763	Nil	No event	44	23:39 Urban
<b>89</b>	159	Nil	No event	62	00:56 Urban
<b>90</b>	421	421	No Event	83	08:05 A' Roads / villages
<b>91</b>	61	Nil	No event	73	20:54 Dual Lit
<b>92</b>	<b>301</b>	<b>160</b>	<b>Vehicle pursuit. Driver subsequently decamped and ran off</b>	<b>50</b>	<b>12:40 Urban / residential streets</b>
	<b>20,074 sec (3hrs, 34 min, 34s)</b>	<b>6559 sec (1hr, 50 min, 11 sec)</b>			

**Total Clips 92 (Blue Light 55 , Non Blue Light 37)**

**MARKED POLICE VEHICLE  
DATA CAPTURE (DASHCAM)**

	<b>Video Duration (secs)</b>	<b>Blue Light Activation Duration (secs)</b>	<b>Event</b>	<b>Highest speed</b>	<b>Time of day /Location</b>
BL1	61	61	Queuing traffic. Lane 3 moving. All traffic moved over, and PV went through centre with no issues		08:41 Dual
BL2	61	61	No event		08:42 M'Way
BL3	61	30	No event		06:58 Dual
Non1	301	0	No event		16:46 City
Non2	61	0	No event		06:55 Urban
Non3	61	0	No event		06:56 Urban
Non4	61	0	No event		06:57 Dual
Non5	61	0	No event		06:59 Dual
Non6	61	0	No event		07:00 Dual
Non7	61	0	No event		07:01 M'Way
Non8	61	0	No event		07:02 M'Way
Non9	61	Nil	No event		07:03 M'Way
Non10	61	Nil	No event		07:04 M'Way
Non11	61	Nil	No event		07:05 Dual
Non12	61	Nil	No event		07:06 Dual
BL4	61	61	No event		08:43 M'Way
<b>BL5</b>	<b>61</b>	<b>61</b>	<b>Van does not notice for 25 seconds before moving over</b>		<b>08:44 M'Way</b>
BL6	61	61	No event		08:45 M'Way
BL7	61	61	All vehicles moved as soon as it was safe to do so		08:46 M'way slip
BL8	61	61	One vehicle slowed in RH lane to almost a stop (17s into clip) PV had free passage around		08:47 Dual
<b>BL9</b>	<b>61</b>	<b>61</b>	<b>Lorry did not move for 10s despite PV using horn to get attention</b>		<b>08:48 Dual</b>
BL10	61	61	No event		08:49 Dual
Non13	61	Nil	No event		09:06 Dual
Non14	61	Nil	No event		09:10 Dual
Non15	61	Nil	No event		09:11 Dual
Non16	61	Nil	No event		09:12 Dual
Non17	61	Nil	No event		09:13 Dual

Non18	61	Nil	No event	09:15 Dual
Non19	61	Nil	No event	09:16 Dual
Non20	61	Nil	No event	09:16 Dual
Non21	181	Nil	No event	09:17 Urban
Non22	61	Nil	No event	09:17 Dual Queue
Non23	61	Nil	No event	09:18 Urban (Business Park)
Non24	61	Nil	No event	9:20 Urban (Business Park)
Non25	181	Nil	No event	09:20 Urban (Business Park)
BL11	61	61	Two Police vehicles (footage from Vehicle 2). No event	10:01 Urban Residential
BL12	61	61	Two Police vehicles (footage from Vehicle 2). No event	10:02 Urban Residential
BL13	61	61	No event	17:23 Urban Residential
BL14	61	30	No event	10:03 Urban Residential
Non26	61	Nil	No event	10:04 Urban Residential
Non27	61	Nil	No event	10:05 Urban Residential
Non28	181	Nil	No event	10:06 A' Road
Non29	61	Nil	No event	10:06 Urban Residential
Non30	61	Nil	No event	10:07 Urban Residential
Non31	61	Nil	No event	10:08 Urban Residential
Non32	61	Nil	No event	10:09 Urban Residential
Non33	61	Nil	No event	10:09 Urban Residential
Non34	61	Nil	No event	10:10 Urban Residential
Non35	61	Nil	No event	10:11 Urban Residential
Non36	61	Nil	No event	10:12

				Urban Residential
Non37	61	Nil	No event	10:12 Urban Residential
Non38	61	Nil	No event	10:13 Urban Residential
Non39	61	Nil	No event	10:14 Urban Residential
Non40	61	Nil	No event	10:15 Urban Residential
Non41	61	Nil	No event	10:15 Urban Residential
Non42	61	Nil	No event	10:16 Urban Residential
Non43	61	Nil	No event	10:17 Urban Residential
Non44	181	Nil	No event	10:18 A' Road
Non45	61	Nil	No event	10:18 Urban
Non46	61	Nil	No event	10:19 A' Road
Non47	61	Nil	No event	10:20 A' Road
Non48	61	Nil	No event	10:21 Urban Residential
Non49	61	Nil	No event	10:21 Dual
Non50	61	Nil	No event	10:22 Dual
Non51	61	Nil	No event	10:23 Dual
Non52	61	Nil	No event	10:24 Urban
Non53	61	Nil	No event	10:24 M'Way
Non54	61	Nil	No event	10:25 M'Way
Non55	61	Nil	No event	10:26 M'Way
Non56	181	Nil	No event	10:27 Urban
Non57	61	Nil	No event	10:27 M'Way
Non58	61	Nil	No event	10:28 M'Way
Non59	61	Nil	No event	10:29 M'Way
Non60	61	Nil	No event	10:30 M'Way
Non61	61	Nil	No event	10:31 M'Way
Non62	61	Nil	No event	10:32 M'Way
Non63	61	Nil	No event	10:33 M'Way
Non64	61	Nil	No event	10:34

				M'Way
Non65	61	Nil	No event	10:35 M'Way
Non66	61	Nil	No event	10:36 M'Way
Non67	61	Nil	No event	10:37 Dual
Non68	61	Nil	No event	10:38 Dual
Non69	61	Nil	No event	10:39 Dual
Non70	61	Nil	No event	10:40 Dual
Non71	61	Nil	No event	10:41 Dual
Non72	61	Nil	No event	10:42 Dual
Non73	181	Nil	No event	11:01 Dual
Non74	181	Nil	No event	11:04 Urban Dual C'way
Non75	181	Nil	No event	11:07 City
Non76	181	Nil	No event	11:12 City
Non77	181	Nil	No event	11:15 City
Non78	61	Nil	No event	13:29 Business Park
Non79	61	Nil	No event	13:31 A' Road
BL15	181	100	No event	14:33 M'Way
Non80	181	Nil	No event	14:36 M'Way
Non81	181	Nil	No event	14:30 Dual
Non82	181	Nil	No event	14:39 Dual
Non83	61	Nil	No event	13:44 Urban Dual C'way
Non84	61	Nil	No event	13:45 Urban Dual
Non85	61	Nil	No event	13:34 Residential
Non86	61	Nil	No event	13:43 Dual
Non87	61	Nil	No event	13:30 A' Road
Non88	61	Nil	No event	13:32 A' Road
Non89	61	Nil	No event	13:22 Ind Est
Non90	61	Nil	No event	13:25 Ind Est
BL16	61	61	No event	13:23 Ind Est
Non91	61	Nil	No event	13:21 Ind Est
Non92	61	Nil	No event	13:26 Ind Est
Non93	61	Nil	No event	12:48

				Residential
Non94	61	Nil	No event	12:43 Urban
Non95	181	Nil	No event	11:25 Residential
Non96	181	Nil	No event	11:22 Residential
Non97	61	Nil	No event	12:42 Residential
Non98	181	Nil	No event	11:16 Residential
Non99	181	Nil	No event	11:19 Car Park / Urban
Non100	181	Nil	No event	11:31 Residential
Non101	181	Nil	No event	11:37 Residential /Urban
Non102	61	Nil	No event	11:43 Urban
Non103	61	Nil	No event	12:46 Residential
Non104	181	Nil	No event	11:31 Residential
Non105	181	Nil	No event	11:34 Residential
Non106	61	Nil	No event	11:39 Urban
Non107	61	Nil	No event	11:40 Urban
Non108	181	Nil	No event	11:40 Urban
Non109	61	Nil	No event	11:41 Urban
Non110	61	Nil	No event	13:41 A' Road
Non111	61	Nil	No event	13:42 A' Road
Non112	61	Nil	No event	13:40 Urban Ind Est
Non113	61	Nil	No event	13:39 Residential
Non114	61	Nil	No event	11:42 Urban
Non115	181	Nil	No event	11:43 Residential
Non116	61	Nil	No event	11:45 Urban Ind Est
Non117	61	Nil	No event	11:45 Industrial Est
Non118	181	Nil	No event	11:46 Urban
<b>BL17</b>	<b>181</b>	<b>181</b>	<b>One vehicle moved late on slip road – caused a 2 s delay (@50s in clip).</b>	<b>11:49 Urban / M'Way</b>
<b>BL18</b>	<b>181</b>	<b>107</b>	<b>Van did not notice for 11s before moving to Lane 1</b>	<b>11:52 Dual</b>
Non119	61	0	No event	11:53 City
Non120	61	0	No event	11:54 Urban
Non121	181	0	No event	11:55

				Business Park
Non122	61	0	No event	11:55 Dual
Non123	61	0	No event	11:56 Dual
Non124	61	0	No event	11:57 Commercial
Non125	61	0	No event	11:58 Commercial
BL19	181	181	No event	12:07 Dual
Non126	181	0	No event	12:10 Dual
Non127	181	0	No event	12:13 City
Non128	61	0	No event	12:16 Business Park
Non129	181	0	No event	12:16 City
Non130	61	0	No event	12:16 Villages
Non131	61	0	No event	12:17 Urban
Non132	61	0	No event	12:18 Urban
Non133	61	0	No event	12:19 Urban
Non134	61	0	No event	12:20 Rural
Non135	61	0	No event	12:21 Rural
Non136	61	0	No event	12:22 Dual
Non137	61	0	No event	12:23 Dual
Non138	61	0	No event	12:24 Dual
Non139	181	0	No event	12:28 Urban
BL20	61	61	No event	12:25 M'Way
<b>BL21</b>	<b>61</b>	<b>61</b>	<b>Van did not move for 8 seconds</b>	<b>12:26 M'Way</b>
BL22	61	61	No event	12:27 M'Way
BL23	61	61	No event	12:28 M'Way
<b>BL24</b>	<b>61</b>	<b>61</b>	<b>Vehicle in Lane 3 did not react for 8 seconds even though Lane 2 was clear</b>	<b>12:29 M'Way</b>
BL25	61	61	No event	12:30 M'Way
Non140	181	0	No event	12:31 Urban
BL26	61	61	No event	12:31 M'Way
BL27	61	61	No event	12:32 M'Way
BL28	61	61	No event	12:33 M'Way
Non141	181	0	No event	12:34 Urban
<b>BL29</b>	<b>61</b>	<b>61</b>	<b>PV tried to move past traffic. PV moved into Roadworks to</b>	<b>12:34 Dual</b>

<b>pass on the left but 4x4 did the same</b>				
BL30	61	0	No event	12:35 Dual
Non142	61	0	No event	12:36 Dual
Non143	181	0	No event	12:37 City
Non144	61	0	No event	12:37 Urban
Non145	61	0	No event	12:38 Urban
Non146	61	0	No event	12:39 Urban
Non147	181	0	No event	12:40 City
Non148	61	0	No event	12:41 Urban
Non149	61	0	No event	12:41 Residential
Non150	61	0	No event	12:42 Residential
Non151	181	0	No event	12:43 Urban
Non152	61	0	No event	12:44 Residential
Non153	61	0	No event	12:45 Residential
Non154	181	0	No event	12:46 Residential
Non155	181	0	No event	12:49 Rural / Semi Rural
Non156	61	0	No event	12:49 Semi Rural
Non157	61	0	No event	12:50 Semi Rural
Non158	61	0	No event	12:51 Semi Rural
Non159	61	0	No event	13:12 Industrial Area near Docks
Non160	61	0	No event	12:52 Industrial Area
Non161	61	0	No event	12:53 Industrial Area
Non162	61	0	No event	12:54 Rural
Non163	61	0	No event	12:55 Rural
Non164	61	0	No event	12:56 Rural
Non165	61	0	No event	12:57 Rural
Non166	61	0	No event	12:58 Rural
Non167	61	0	No event	12:59 Rural/ Industrial Area
Non168	61	0	No event	13:00

				Industrial Area
Non169	61	0	No event	13:01 Rural
Non170	61	0	No event	13:03 Rural
Non171	61	0	No event	13:03 Rural
Non172	61	0	No event	13:04 Industrial Area
Non173	61	0	No event	13:06 A' Road
Non174	61	0	No event	13:06 A' Road
Non175	61	0	No event	13:07 A' Road
Non176	61	0	No event	13:08 A' Road
Non177	61	0	No event	13:09 A' Road / Industrial Area
Non178	61	0	No event	13:10 Industrial Area
Non179	61	0	No event	13:11 Industrial Area
Non180	61	0	No event	13:13 Industrial Area
Non181	61	0	No event	13:14 Industrial Area
Non182	61	0	No event	13:15 Industrial Area
Non183	61	0	No event	13:17 Industrial Area
Non184	61	0	No event	13:24 Industrial Area
Non185	61	0	No event	13:27 Industrial Area
Non186	61	0	No event	13:20 Industrial Area
Non187	61	0	No event	13:17 Industrial Area
Non188	61	0	No event	13:18 Industrial Area
Non189	61	0	No event	13:19 Industrial Area
Non190	61	0	No event	13:33 Urban
Non191	61	0	No event	13:35 Urban
Non192	61	0	No event	13:38 Industrial Area

Non193	301	0	No event	17:04 Dual
<b>BL31</b>	<b>301</b>	<b>128</b>	<b>Vehicles parted at traffic lights. PV positioned to go through centre of two lanes. 184 s into clip 1 vehicle on the pavement and 2 crossed the red light</b>	<b>13:54 City</b>
Non194	301	0	No event	18:55 Dual
Non195	301	0	No event	14:48 Urban
BL32	301	301	No event	20:07 A' Road
Non196	301	0	No event	17:53 Industrial Area
Non197	301	0	No event	17:09 City
Non198	301	0	No event	17:58 City
<b>BL33</b>	<b>301</b>	<b>301</b>	<b>@146s on clip: Queue at traffic lights. Vehicles undecided which way to move. Vehicles also crossed line at Traffic lights</b>	<b>18:16 City</b>
BL34	301	142	No event	18:34 City
Non199	301	0	No event	17:35 A' Road
BL36	301	301	No event	09:00 Urban
<b>BL37</b>	<b>301</b>	<b>76</b>	<b>Vehicle mounted pavement to move to RH side as PV also travelled up the right (298s into clip)</b>	<b>12:55 Urban</b>
BL38	301	21	Pulled car over on approach to roundabout. No adverse reaction	08:56 Dual
Non200	301	0	No event	19:10 Dual
Non201	301	0	No event	19:11 Urban
Non202	301	0	No event	19:16 Urban
Non203	301	0	No event	19:21 Urban
BL39	301	14	BL used to pull car over. No adverse event	19:26 Urban
Non204	301	0	No event	19:41 Urban
Non205	301	0	No event	19:46 Dual/ City
Non206	301	0	No event	19:56 City
Non207	301	0	No event	20:01 M'Way / Dual
BL40	301	77	No event	04:38 City
Non208	208	0	No event	19:00 A' Road
<b>BL41</b>	<b>301</b>	<b>231</b>	<b>Car in Lane 3 (filter lane mounted grass on RHS (Central Reservation) – 181 s into clip.</b>	<b>20:11 Dual / Urban</b>

			<b>2<sup>nd</sup> Vehicle on crossroads very hesitant. Green Traffic lights for third party , PV on Red.</b>	
BL42	301	118	No event	20:15 Dual / Urban
Non209	301	0	No event	20:20 Residential
<b>BL43</b>	<b>301</b>	<b>116</b>	<b>Car stopped at Junction n green light. Vehicle in RH lane also stopped which caused an obstruction.</b>	<b>20:25</b> <b>Residential / City</b>
<b>BL44</b>	<b>301</b>	<b>301</b>	<b>1.Car crossed Red light into Box junction and blocked part of road for oncoming traffic. 2. Taxi pulled out and obstructed traffic causing delay of 23s.</b>	<b>20:30</b> <b>Urban / City</b>
BL45	301	301	No event	20:35 City
<b>BL46</b>	<b>301</b>	<b>301</b>	<b>Heavy Traffic. City Dual C'way. 1. Coach mounts pavement next to bus stop and petrol station to make space. 2. Vehicle on RH lane mounts a very high kerb 3. 2<sup>nd</sup> small coach mounts pavement 4. 2 Vehicles cross over red traffic lights to make space</b>	<b>20:40</b> <b>City</b>
Non210	301	0	No event	21:05 Residential
Non211	301	0	No event	21:09 Residential
Non212	301	0	No event	21:27 City
Non213	301	0	No event	21:31 City
Non214	301	0	No event	21:36 Dual
BL47	301	202	No event	21:56 City
BL48	301	278	No event	22:01 City
BL49	301	101	No event	22:15 City
<b>BL50</b>	<b>301</b>	<b>110</b>	<b>1 van crossed line at red traffic light to move out of the way</b>	<b>22:18</b> <b>City</b>
Non215	301	0	No event	22:24 City
Non216	301	0	No event	22:29 City
Non217	301	0	No event	22:58 City
Non218	301	0	No event	23:03 City
Non219	301	0	No event	23:08 City
Non220	301	0	No event	23:13 Urban / Rural
Non221	301	0	No event	23:18

				Urban
Non222	301	0	No event	23:34 Residential
Non223	301	0	No event	23:28 Urban
BL51	301	0	No event	03:29 M'Way
Non224	301	0	No event	23:33 M'Way
Non225	301	0	No event	22:43 M'Way
BL52	301	301	No event	00:01 Urban
BL53	301	145	No event	00:06 Urban
BL54	301	301	No event	03:54 Industrial Area / City
Non226	301	0	No event	21:11 Residential
BL55	301	20	No event	23:56 Residential
<b>35219 seconds - 9 hours, 59m 7s</b>		<b>6219 seconds 1 hour, 43m, 39s</b>		

Total Number of clips: 281 (Blue Light 55, Non Blue Light 226)

### Police driving expert analysis

<b>Expert A BL5</b>	The van driver is not searching his mirrors. Two drivers did move over and in lane 2 they are braking because of the Police Vehicle. There was no visual reaction to the strobe lights even though it was a straight road and the Police Vehicle would have been visible from some distance away. They would have had 10 – 12 seconds to react. 5 seconds is within the scope of reasonable reaction time for a driver.
<b>Expert A BL17</b>	The Police Vehicle was undertaking other drivers on complex junctions and holding back would have been more appropriate. Additionally, he has cut across a solid white line which is not permitted. The Police Vehicle is very aggressive in his manner of driving. This meant that the Public did not have enough time to react. They were put under pressure due to the Police Vehicles speed as he was approaching from behind.
<b>Expert A BL21</b>	The Van driver is distracted as he has not gathered the information and then instinctively brakes when he does notice the Police Vehicle behind. We can only hypothesise as to why he is not checking.
<b>Expert A BL29</b>	The Police Vehicle should have held back to give the 4 x 4 more time. The Police driver is clearly familiar with the road. The 4 x 4 had the perception they were being helpful by giving more room with the Police Vehicle not anticipating his actions.
<b>Expert A BL31</b>	Clearly pushing the public out to the way. The public are trying to help and saw others move so think is ok to do the same. It was not an unsafe move as it was slow speed but could cause damage to the tyres.
<b>Expert A BL37</b>	The public were mostly moving ok. The Van driver was delayed in moving by 6 – 7 seconds with good visibility but did not see the Police Vehicle. There were plenty of opportunities to move across earlier. The Police Vehicle was approaching the junction and forced the drivers on to the pavements so gave them little choice.

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No restraint shown on the part of the Police Vehicle.

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**Expert A BL43**

This was at night so there is likely to be more visual confusion. There is a lot of information to process for both the Police and public. The Police Vehicle was not giving the public time to react and did not hold back. Police driver squeezed through left hand gap past a learner driver. At the traffic lights the driver was being helpful but was clearly pressured by the Police driver who was displaying a high level of overconfidence.

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**Expert A BL46**

Police driver was too aggressive and should have held back and waited if there is no clear way through. Very pushy Police driver. The Police Vehicle is consistently pressuring drivers into having to do something which is risky for causing damage. The Police driver is not adhering to the protection of life and property.

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**Expert A CD56**

The Van driver was very late in reacting on a clear road, but it is not possible to speculate as to why that was the case.

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**Expert A CD67**

As the Police drivers had been driving for some considerable time on blue lights, and at high speed, it is possible their Blood Pressure was raised. This may explain the very poorly executed TPAC manoeuvre. They did not allow for multiple vehicles and the ordinary motorists would clearly not be expecting a convoy.

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**Expert A CD25 (unmarked)**

The Police Vehicle is travelling between 110 and 120mph in Lane 3 of the Motorway and the conditions are really good with it being dry and bright. My concern is that the traffic in Lane 2 is quite heavy and if a vehicle decided to move across to Lane 3 the Police Vehicle would have little, if any, time to react safely. The Police vehicle is impeded by a Motorhome for several seconds which has not seen it approaching from behind. However, in the civilian driver's defence it is a large vehicle and the Police Vehicle would have covered a distance of around 120m in 2 seconds. The Police vehicle reduces their speed to around 90mph but is quite close behind and is probably in the Motorhomes blind spot. The Police driver should be sat off or nearside to try

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to gain the Motorhome drivers attention. I can see fault on both sides.

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<b>Expert A CD28 (unmarked)</b>	The conditions appear really good and the traffic is light, so I think the Police vehicle speed is appropriate at an average 115mph. There is little traffic in Lane 2 to cause a problem. Several cars appear to have seen the approaching vehicle and have moved across although one car, a Corsa, did not immediately see it and caused the Police Vehicle to reduce their speed to around 90mph. Failure to use their mirrors caused the delay as the vehicle size is not prohibitive from the civilian point of view, even if the Police Vehicle is unmarked.
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<b>Expert B BL5</b>	The Van driver has not noticed the Police Vehicle and the Officer should have used his position better. The late observation could be, in part, due to the size of the vehicle but Police drivers are trained to realise this. It is a combination of both van design and poor observation. Acceptable reaction time would be between 3 – 4 seconds.
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<b>Expert B BL17</b>	The Police Vehicle is driving illegally over the white lines which contravenes legislation. They have come up behind the public too quickly which does not allow the public time to react safely and pushes them on to the hard shoulder. The public therefore have to take evasive action. At Junction 32 the Police Vehicle went left around the van instead of right which in turn affected the Vans reaction.
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<b>Expert B BL21</b>	There was no retardation by the Police Vehicle to allow the public time and their presence was not picked up due to the height of the van. If the Police Vehicle is too close and the headlights are flashing the Van driver may not see the lights in the mirror, but he needs to be checking earlier anyway and on a more regular basis.
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<b>Expert B BL29</b>	The Police vehicle should certainly not be using the roadworks section to get through the traffic. It would have been better to switch off the lights and allow the public to move out of the way naturally rather than potentially put roadworkers in danger.
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<b>Expert B BL31</b>	I am happy with the way the public moved over and parked. The speed of the Police Vehicle also seemed ok.
<b>Expert B BL37</b>	I think the driving from the public is fine, but the Police driver is overly aggressive to get the Van to move out of the way. They committed too early with the bus and did not give the public time to get to a place of safety.
<b>Expert B BL43</b>	There were multiple junctions and with the Police driver forcing a decision it caused the civilian driver to stop. The response manual states that you must not come into contact with other road users which is not being adhered to in this instance.
<b>Expert B BL46</b>	The Police Vehicle once again force the ordinary driver to make a decision. Could the nature of the call have dictated the lights / sirens being turned off in training?
<b>Expert B CD56</b>	The Police Vehicle approached from behind very quickly – 96mph forcing the car to make a decision. If they are covering 150 feet / second, the public need to be checking their mirrors every 10 seconds or so and would simply not have had time to see them earlier. It would be a natural reaction for the van driver to hit the brakes without conscious thought.
<b>Expert B CD67</b>	Already reviewed
<b>Expert B CD25 (unmarked)</b>	The Police Vehicle was too quick approaching the car on the left. As it is in the middle lane it may have moved out to the right leaving the police vehicle nowhere else to go. Average speed was 110 – 120mph in good conditions. Being unmarked compounds the problem as they are not looking for that type of vehicle. The camper construction means the driver would find it harder to see.
<b>Expert B CD28 (unmarked)</b>	The Police Vehicle was far too fast in Lane 2 not allowing the cars to move out of the way in time.

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Overly aggressive driving which may cause the public to make a wrong decision.

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**Expert C BL5**

It is evident that the Police vehicle is using lights and sirens on the Motorway. It looks a little overcast, but the visibility seems ok. The traffic is flowing well and there are plenty of opportunities for the vehicles ahead to move over. The Police vehicle would have been noticeable to the van in front for at least 300m as the lane is clear and straight. Whilst it cannot move to the centre lane at this point due to traffic, there is no attempt to do so such as indicating left, highlighting that the van driver is unaware of its presence. Even after the 10 seconds it took for the Police vehicle to reach them the van still has not moved over in to the clear space available. The van has finally realised after 25 seconds and indicated left. The Police vehicle has changed the siren tone a couple of times to raise awareness. Whilst a larger vehicle the wing mirrors are visible which means if we can see the mirrors the van driver should be able to see the Police vehicle. The van delay is unacceptable, but the Police driver could have helped by varying their lane position a little more.

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**Expert C BL17**

The Police car has joined the Motorway at J32 of the M4. Traffic was light on the adjoining roundabout and moved promptly. The Motorway itself is clear and the Police driver has headed directly for Lane 3. Heading towards J33 the traffic is flowing freely although a little bunched with a small car ahead. This notices the Police car but only after about 10 to 12 seconds. The Police driver has decided to take the exit and moves to the left just behind another car as it joins the exit slip. The Police driver swerves back out to go in front of it on the slip road. This forces the car far to the left and essentially on the hard shoulder. It does the same at the top of the slip road and when joining the main carriageway crosses over the solid hatch markings. This was not necessary as the lane was clear enough ahead. The Police driver whilst responding seems to be a little aggressive in their overall approach.

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**Expert C BL21**

The Police car is in Lane 3 of the Motorway travelling at a significant speed compared to the other traffic it is passing. Ahead is a small bunching of cars but flowing well. The red polo has moved over quickly with no noticeable delay. The white Citroen Despatch van, a small panel van, in front of the Polo then has at least 8 seconds to move across in to Lane 2 which was clear. This slowed the Police driver and is too long for the Van driver. He has not noticed the car in a reasonable amount of time. The left hand van mirror was visible to the Police driver from behind although the right hand one was not. The van driver should have acted earlier whilst the Police driver could have moved left or right slightly to aid awareness.

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**Expert C BL29**

The Police car is with lights and sirens. There are signs to say roadworks ahead as they approach the roundabout leading to J32. They have had no issues until finding slow traffic ahead due to the two lanes becoming one. The 4x4 decides to enter the closed lane just at the same time as the police do so. The Police driver has to come back out but then enters it again to proceed. This has potential implications as there was a maintenance vehicle and worker there already, but the Police driver squeezes through. It is not possible to know what emergency they were attending but I would question if this manoeuvre was worth the time saving.

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**Expert C BL31**

The Police car is travelling in one of the built areas of Cardiff during the early afternoon in good weather. The blue lights were operational, and the police driver held back until everybody appeared to be moving across. They went

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through the centre of the two lanes, which was queuing at traffic lights on the bridge, as would be expected. The public have all mounted the pavement on the right but there was a cycle lane on the left which helped in order to make space. As the run has continued the traffic is light and the public seem to have noticed the Police car in good time both in front and opposing traffic flows.

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**Expert C BL37**

The Police car is travelling through Coryton with the Blue lights on during the day. It is not possible to tell if any of the other systems were in place. It is reasonably residential with several junctions either side of the main road. There is a large white van ahead (Citroen Relay) which did not move for 11 seconds but did have the opportunity to do so. The cars ahead as the driver approaches a roundabout do appear to have noticed the police car in good time and have all moved over to the left as much as possible whilst the police car heads down the centre of the road.



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**Expert C BL43**

The Police car is travelling in a built up area in the centre of Cardiff around 8.30pm. There are street lights but the road is clearly wet with quite a lot of traffic particularly around the junctions. There was one occasion where the public had not noticed the police behind, but the delay was minimal. However, for the conditions the police seem to be travelling too fast. They have made a number of manoeuvres which I believe are risky considering the amount of information that is needed to be processed.

**Expert C BL46**

The car is travelling out of Cardiff on North Road and there is very heavy traffic. The blue lights are clearly on and the public are trying to move across in the space they have. Unfortunately, there is a pavement on the left with a lot of street furniture and a high kerb to the right with a barrier. Despite this they are trying to make space but risk damaging their cars. Whilst the Police driver is trying to go through the centre a number of cars are trying to move to the left lane of the two. The Police driver despite this is using gaps on the left even if a car is indicating to move to the same side.



There were no occasions where the public were unaware that there was a police car behind and whilst they are trying to move over in the space available the police driver is being very aggressive in trying to get through before it is probably safe.

**Expert C CD56**

Travelling north on the A470 which a dual carriageway the traffic appears light. The driver has reached speeds on 126mph but eased off as they approached the traffic some distance ahead to 96mph. By the time they reached the large LWB van the speed had reduced to 76 mph as

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the van took 11 seconds to move across. I would have expected it to do so in much less time as the police driver was not being pushy and had allowed enough space. It is not possible to establish why the van took so long as there was a curve in the road so checking the left hand mirror would have aided the van driver who otherwise may have had restricted vision. The police driver was not too close at any point so unlikely to be in their blind spot.

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**Expert C CD67**

After a drive in relative convoy along the Motorway for about 15 minutes the Police drivers were apparently instructed to stop the vehicle using a TPAC. Throughout the drive a Police helicopter can also be seen in the vicinity who may have been passing on location information regarding the target vehicle. However, the TPAC was very badly initiated as they forced an HGV to stop abruptly and road dust can be seen coming from the wheels. I actually consider their actions dangerous and they are fortunate the outcome was as it is. The drivers I would suggest were running on adrenalin which may have affected judgement.

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**Expert C CD25 (unmarked)**

The police car which is apparently unmarked was travelling at some occasions in excess of 120mph. There was plenty of free space in Lane 2 in good conditions and light traffic. The Police car has approached a motorhome in lane 3 which did not move across for at least 10 seconds. This forced the unmarked car to reduce speeds to around 75mph. The delay from the Motorhome whilst too long was compounded by the distance the unmarked car then sat behind. Considering the speed and the fact the Motorhome is a large wide vehicle they would have found it very difficult to know there was a police vehicle behind them and certainly would not have been able to see the covert lighting. Additionally, there is a possibility the Motorhome was not UK registered due to the colour of the rear number plate seemingly white which would mean the driver was on the left not right. The police car should most definitely have held back.

**Expert C CD28 (unmarked)**

The Police car, travelling in Lane 3 on the Motorway had a clear run reaching speeds of up to 123mph. Considering it was unmarked this however was not a problem as there was little traffic. As the road gently curved to the left there was two small cars ahead of about 400m away. The Police driver has dropped to around 100mph and the 2<sup>nd</sup> car (ahead of the closest vehicle) has moved to the left into the centre lane. This may be because the car behind them was quite close or the driver has seen the approaching Police vehicle, but it is not possible to clarify this. However, the car immediately in front has failed to notice the Police car and stayed in the same lane for around 8 seconds. This is too long and suggests the driver was not checking their mirrors but it is not possible to speculate as to why they were not.



## Emergency Vehicle interaction Survey

This questionnaire forms part of a wider body of research for a PhD. It considers the reactions and feelings of drivers, both general and from the UK Emergency services, and is looking at how they interact with one another when the Emergency vehicle is making passage through to an onward incident.

1. Please state your gender

2. Driver Age

- |                                |                             |
|--------------------------------|-----------------------------|
| <input type="radio"/> Under 18 | <input type="radio"/> 45-54 |
| <input type="radio"/> 18-24    | <input type="radio"/> 55-64 |
| <input type="radio"/> 25-34    | <input type="radio"/> 65+   |
| <input type="radio"/> 35-44    |                             |

3. How long have you held a full UK driving licence for?

4. What type of vehicle do you normally drive (Car / Van etc)? Please Specify

5. How old is the vehicle you normally drive?

6. Estimate the approximate number of miles driven during the past year (combining business and pleasure)

- |  |  |
|--|--|
| <input type="checkbox"/> Less than 5,000 miles | <input type="checkbox"/> 15,000 - 20,000 miles |
| <input type="checkbox"/> 5,000 - 10,000 miles  | <input type="checkbox"/> Over 20,000 miles     |
| <input type="checkbox"/> 10,000 - 15,000 miles |  |

7. Please state your main occupation

8. Have you ever needed to move your vehicle out of the way to allow an Emergency Vehicle to pass you?

- Yes  
 No

9. Did you need to move over quickly or was it planned?

10. If you were required to move your position have you ever needed to... : Please mark all that apply

- |  |  |
|--|--|
| <input type="checkbox"/> Reverse                   | <input type="checkbox"/> Move right                    |
| <input type="checkbox"/> Mount a Pavement          | <input type="checkbox"/> Speed up to move quickly      |
| <input type="checkbox"/> Cross a Red Traffic light | <input type="checkbox"/> Stop on a pedestrian crossing |
| <input type="checkbox"/> Move lanes                | <input type="checkbox"/> Other                         |
| <input type="checkbox"/> Move left                 |  |

Other (please specify)

11. What type of road are you usually on when dealing with this type of vehicle?

- Town / City  
 Rural  
 Dual Carriageway / Motorway  
 Mixed road types

12. How do you initially identify an Emergency Vehicle is approaching?

- |  |  |
|--|--|
| <input type="checkbox"/> Sound from the sirens | <input type="checkbox"/> Using your Mirrors    |
| <input type="checkbox"/> Flashing Headlights   | <input type="checkbox"/> Size of the vehicle   |
| <input type="checkbox"/> Flashing Blue Lights  | <input type="checkbox"/> Colour of the vehicle |

13. How far away was the vehicle when you first noticed it? Please state approximate distance in metres

14. If you did not immediately see or hear the Emergency vehicle why was that? Please mark all that apply

- |   |  |
|---|--|
| <input type="checkbox"/> Monotonous roads such as Dual carriageways and Motorways             | <input type="checkbox"/> Distracted  |
| <input type="checkbox"/> Familiar routes that you drive every day                             | <input type="checkbox"/> Did not see or hear anything before the Emergency vehicle arrived |
| <input type="checkbox"/> Noise within the vehicle (such as radio / passengers / road surface) | <input type="checkbox"/> Other   |

Other (please specify)

15. How anxious do you feel when you realise that there is an Emergency vehicle approaching?

- |                                  |  |
|----------------------------------|--|
| <input type="radio"/> Not at all | <input type="radio"/> Most of the time |
| <input type="radio"/> Rarely     | <input type="radio"/> Definitely       |
| <input type="radio"/> Sometimes  |  |

16. Do you consider that you always act in a controlled manner when dealing with an approaching Emergency vehicle?

- |                                  |  |
|----------------------------------|--|
| <input type="radio"/> Not at all | <input type="radio"/> Most of the time |
| <input type="radio"/> Rarely     | <input type="radio"/> Definitely       |
| <input type="radio"/> Sometimes  |  |

17. Do you consider that your choice of new road position is appropriate when waiting for an Emergency vehicle to pass through?

- |                                  |  |
|----------------------------------|--|
| <input type="radio"/> Not at all | <input type="radio"/> Most of the time |
| <input type="radio"/> Rarely     | <input type="radio"/> Definitely       |
| <input type="radio"/> Sometimes  |  |

**Crosstabulation between road type, distance and identification method**

		How do you initially identify an Emergency Vehicle is approaching?						
		Sirens	Headlights	Blue Lights	Mirrors	Size	Colour	Total
How far away was the vehicle when you first noticed it?	Less than 15m	0	0	0	0	0	0	0
	15 – 30m	5	0	5	5	0	1	16
	31 – 50m	6	4	7	6	0	0	23
	51 – 100m	12	5	10	8	0	3	38
	TOWN	100 – 200m	7	2	6	4	0	19
	200 – 300m	5	3	3	4	0	1	16
	300 – 400m	2	1	2	2	0	0	7
	400 – 500m	1	1	2	2	0	0	6
	Unsure	3	0	2	3	0	0	8
	Less than 15m	1	1	1	1	0	0	4
How far away was the vehicle when you first noticed it?	15 – 30m	1	0	1	0	0	0	2
	31 – 50m	0	0	0	0	0	0	0
	51 – 100m	1	1	1	1	0	1	5
	RURAL	100 – 200m	6	3	5	7	0	21
	200 – 300m	1	1	1	1	0	0	4
	300 – 400m	0	0	0	0	0	0	0
	400 – 500m	0	0	0	0	0	0	0
	Unsure	0	0	0	0	0	0	0
	Less than 15m	1	1	1	1	0	1	5
	15 – 30m	0	0	0	0	0	0	0
How far away was the vehicle when you first noticed it?	31 – 50m	2	0	2	3	0	0	7

	<b>51 – 100m</b>	6	3	5	5	0	0	19
MIXED ROAD	<b>100 – 200m</b>	5	0	5	5	0	0	15
	<b>200 – 300m</b>	1	1	1	1	0	0	4
	<b>300 – 400m</b>	1	1	1	1	0	0	4
	<b>400 – 500m</b>	2	1	2	2	0	0	7
	<b>Unsure</b>	1	1	1	1	0	0	4
<i>How far away was the vehicle when you first noticed it?</i>	<b>Less than 15m</b>	0	0	0	0	0	0	0
	<b>15 – 30m</b>	0	0	0	0	0	0	0
	<b>31 – 50m</b>	0	0	0	0	0	0	0
	<b>51 – 100m</b>	2	1	1	1	1	0	6
	<b>DUAL/ M'WAY</b>	0	0	0	0	0	0	0
	<b>100 – 200m</b>	0	0	0	0	0	0	0
	<b>200 – 300m</b>	0	0	0	0	0	0	0
	<b>300 – 400m</b>	0	0	0	0	0	0	0
	<b>400 – 500m</b>	0	0	0	0	0	0	0
	<b>Unsure</b>	0	0	0	0	0	0	0
	<b>TOTAL</b>	72	31	65	64	0	8	240

**Crosstabulation between type of road, age of vehicle and distance identified**

		What type of road are you usually on when dealing with this type of vehicle?					Total
Age of vehicle	How far away?	Town/City		Rural	Mixed	Dual Carriageway/Motorway	
		Road	Motorway				
How far away was the vehicle when you first noticed it?	Less than 15m	0	0	0	0	0	0
	15 – 30m	1	0	0	0	0	1
	31 – 50m	0	0	1	0	0	1
	LESS THAN 2 YEARS	51 – 100m	2	0	0	1	3
	100 – 200m	2	0	0	0	0	2
	200 – 300m	4	0	1	0	0	5
	300 – 400m	1	0	1	0	0	2
	400 – 500m	0	0	1	0	0	1
	Unsure	0	0	0	0	0	0
	Less than 15m	0	1	0	0	0	1
How far away was the vehicle when you first noticed it?	15 – 30m	0	1	0	0	0	1
	31 – 50m	2	0	0	0	0	2
	51 – 100m	6	1	4	1	6	11
	2-5 YEARS	100 – 200m	3	4	4	0	11
	200 – 300m	1	0	0	0	0	1
	300 – 400m	1	0	0	0	0	1
	400 – 500m	0	0	1	0	0	1
	Unsure	0	0	1	0	0	1
	Less than 15m	0	0	1	0	0	1
	15 – 30m	2	0	0	0	0	2
How far away was the vehicle?	Less than 15m	0	0	1	0	0	1
	15 – 30m	2	0	0	0	0	2

<i>How far away was the vehicle when you first noticed it?</i>	<b>31 – 50m</b>	2	0	2	0	4
	<b>51 – 100m</b>	4	0	2	0	6
	<b>6 -10 YEARS</b>	1	2	2	0	5
	<b>100 – 200m</b>					
	<b>200 – 300m</b>	0	1	0	0	1
	<b>300 – 400m</b>	0	0	0	0	0
	<b>400 – 500m</b>	3	0	1	0	4
	<b>Unsure</b>	1	0	0	0	1
	<b>Less than 15m</b>	0	0	0	0	0
	<b>15 – 30m</b>	2	0	0	0	0
<b>11 -15 YEARS</b>	<b>31 – 50m</b>	3	0	0	0	0
	<b>51 – 100m</b>	1	0	0	0	0
	<b>100 – 200m</b>	1	1	0	0	0
	<b>200 – 300m</b>	0	0	0	0	0
	<b>300 – 400m</b>	0	0	0	0	0
	<b>400 – 500m</b>	0	0	0	0	0
	<b>Unsure</b>	1	0	0	0	0
	<b>TOTAL</b>	45	11	22	2	80

**Crosstabulation between type of road, identification type and age of vehicle**

		How do you initially identify an Emergency Vehicle is approaching?						
		Sirens	H/lights	Blue	Mirrors	Size	Colour	Total
		Lights						
How old is the vehicle you normally drive?	Less than 2 years	10	4	9	7	0	3	33
	2 – 5 years	12	4	10	10	0	1	37
	TOWN 6 – 10 years	11	7	12	10	0	1	41
	11 – 15 years	8	1	6	7	0	0	22
How old is the vehicle you normally drive?	Less than 2 years	0	0	0	0	0	0	0
	2 – 5 years	6	3	5	6	0	1	21
	RURAL 6 – 10 years	3	2	3	3	0	0	11
	11 – 15 years	1	1	1	1	0	0	4
How old is the vehicle you normally drive?	Less than 2 years	3	2	3	4	0	0	12
	2 – 5 years	10	4	7	7	0	0	28
	MIXED 6 – 10 years	6	2	8	8	0	1	25
	ROAD 11 – 15 years	0	0	0	0	0	0	0
How old is the vehicle you normally drive?	Less than 2 years	1	0	0	0	0	0	1
	2 – 5 years	1	1	1	1	0	1	5
	DUAL 6 – 10 years	0	0	0	0	0	0	0
	C'WAY/ M'WAY 11 – 15 years	0	0	0	0	0	0	0
TOTAL		72	31	65	64	0	8	240

**Crosstabulation between type of road, and annual mileage**

What type of road are you usually on when dealing with this type of vehicle?					
	Town / City	Rural	Mixed	Dual Carriageway / Motorway	Total
<b>Less than 5,000 miles</b>	8	0	2	0	10
<b>5,000-10,000</b>	12	3	8	0	23
<b>10,000 – 15,000</b>	13	4	2	0	19
<b>15,000-20,000</b>	4	2	3	2	11
<b>Over 20,000</b>	5	2	4	0	11
<b>Did not answer</b>	3	0	3	0	6
<b>Total</b>	45	11	22	2	80

Estimate the approximate number of miles driven  
during the past year (combining business and pleasure)

## **Researcher Training Record**

### **2014**

August (3 days)	AIRSO National Blue Light Users Conference
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September	Emergency Services Show NEC, Birmingham
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### **2015**

January (3 days)	Psychometric profiling Course – Cranfield University
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April	Loughborough University DeSReS poster
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September (3 days)	AIRSO National Blue Light Users Conference - Organiser
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### **2016**

April	Commercial Vehicle Show, NEC Birmingham
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May	AIRSO Road Safety “Brexit” conference
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May	Presenter: Microlise Conference, Ricoh Arena, Coventry “Shortage of drivers in the Logistics Industry”.
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May	Brake Fleet Safety Conference, Solihull, Birmingham
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August	National Blue Light Users Conference - Organiser
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September	Chair of the National Fleet Conference, Leicestershire
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### **2017**

April	Commercial Vehicle Show, NEC Birmingham
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	Writing your Doctoral Thesis, Loughborough Graduate School
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September	National Blue Light Users Conference - Organiser
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### **2018**

April	Driver Metrics Conference, Cranfield University
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April	Fleet Show, NEC
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August	National Blue Light Users Conference - Attended
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December	OCR Transport Manager National and International CPC Qualification
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### **2019**

July	FORS Train the Trainer (Fleet Operator Recognition Scheme)
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### **2020**

March	Drug, Solvent and Alcohol Abuse Counselling Certificate
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April	CPC – Drivers Hours, Drink and Drug Awareness, Speed Awareness
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